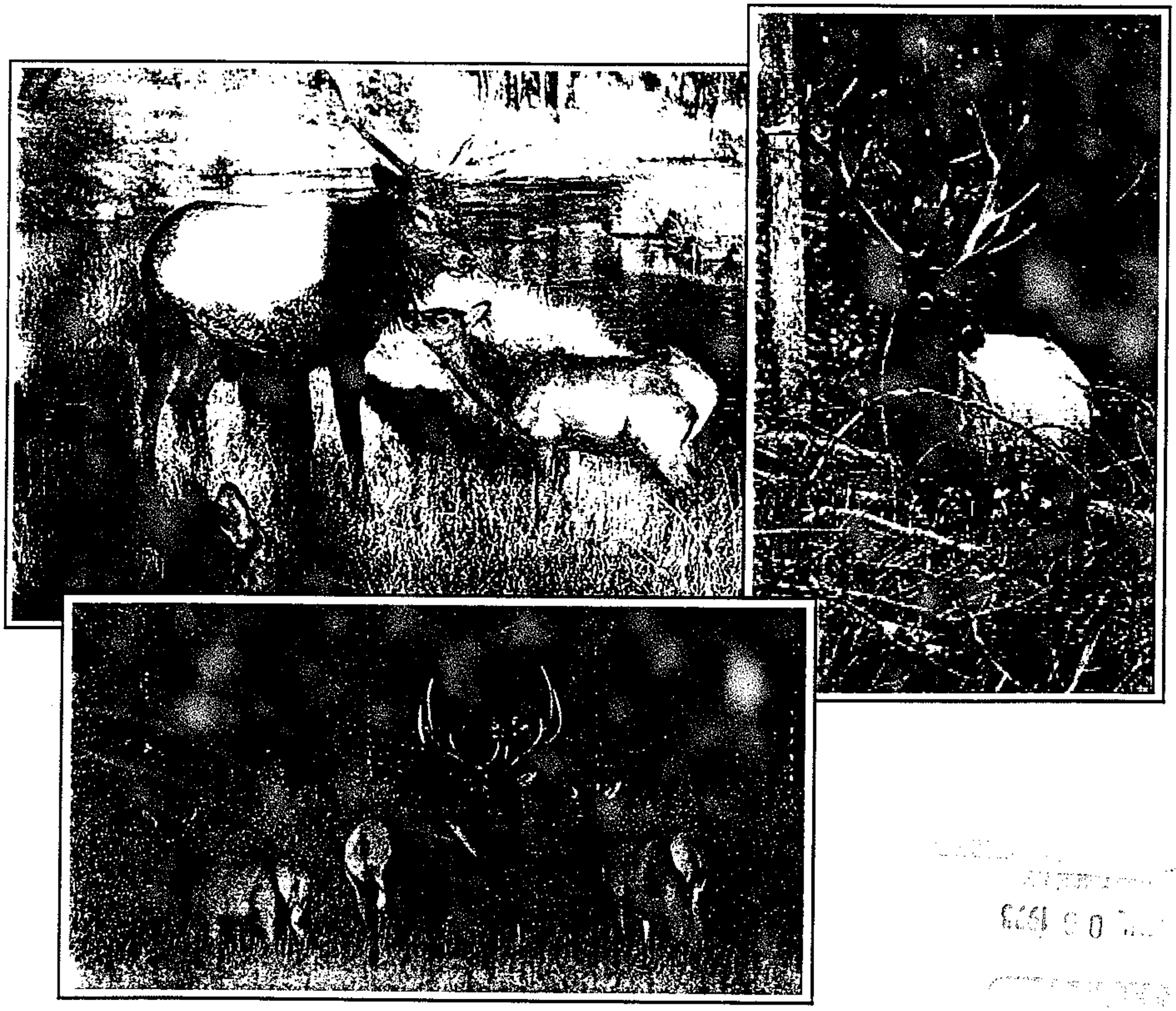
Interagency Guidelines for

Evaluating and Managing Elk Habitats and Populations in Central Idaho



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Interagency Guidelines for Evaluating and Managing Elk Habitats and Populations in Central Idaho

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ABSTRACT

This document provides information on elk guidelines and management in north-central Idaho. Recommendations and guidelines for integrating access management, logging, road building and livestock grazing with elk summer habitat preferences and fall hunting seasons are outlined. An elk habitat effectiveness (EHE) model computes habitat effectiveness using the density of open roads; quality, quantity and distribution of cover, forage, and security areas; and livestock use. An elk vulnerability (EV) model for estimating the effects of access and hunter management activities during fall hunting seasons is outlined. Elk vulnerability considers open road densities and hunter density by big game management unit. These guidelines require an integrated approach to habitat and population management on U.S. Forest Service (USFS) lands in north-central Idaho.

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PREFACE

For the Blue Mountains of Oregon and Washington, Black et al. (1976) developed a procedure for coordinating silvicultural activities with elk and deer habitat needs. In 1977, a self-appointed committee of Dean Carrier (U.S. Forest Service), Joe Lint (Bureau of Land Management), Larry Irwin (then at the University of Idaho), and Tom Leege (Idaho Department of Fish and Game), served as a stimulus to modify the "Blue Mountain" system for northern Idaho (USFS 1977). A series of meetings in 1981 and 1982 with representatives of all the above agencies as well as the Plum Creek Timber Company and Potlatch Corporation developed the north Idaho model. Recommendations from those meetings were incorporated into the elk habitat effectiveness model developed by Leege in 1984 and represented the latest research findings as well as a consensus of opinions from numerous resource specialists (see Leege 1984).

In February 1992, the Clearwater Region of IDFG, the Clearwater National Forest (CNF) and Nez Perce National Forest (NPNF), and the Nez Perce Tribe (NPT) entered into a project to more closely integrate their management efforts. As part of that project, two technical teams of forest, tribal, and state biologists met to evaluate the implementation of the elk habitat effectiveness model published by Leege in 1984 and to devise and implement a measure of elk vulnerability. The teams devised a consistent and standardized application of Leege (1984) and a vulnerability model for use at the game management unit scale. The teams updated the assumptions, rules, and recommendations in Leege (1984) based on current research and management consensus. To standardize and update the measure of elk habitat effectiveness in Leege (1984) the guidelines: 1) outline the boundary delineation process for elk analysis areas (EAA's), 2) define roads and their corresponding coefficients to connect USFS databases with variables used in the EHE model, 3) eliminate the double counting of roads in Leege's 1984 model, 4) define the use and effect of hiding and thermal cover, and 5) eliminate the existing and long-term potential elk use portion of the EHE model. The teams efforts, represented in these guidelines, are an evolution not revolution of Leege (1984). These guidelines do not replace the need for professional judgement of wildlife biologists based on site-specific knowledge. The guidelines should be adapted as additional information becomes available.

PURPOSE OF GUIDELINES

These guidelines provide the IDFG Clearwater Region and the CNF and NPNF a tool for management of elk populations and habitats on public lands in the IDFG Clearwater Region and NPT-ceded lands. The guidelines provide for consistent management and evaluation of EHE and EV between USFS and IDFG using [illegible] public participation. The guidelines are not a decisional document, but they assist IDFG and the USFS in setting common forest and species plan objectives and consistent management and evaluation of EHE and EV.

INTRODUCTION

Northern Idaho offers some of the most productive elk habitats and populations in the country, resulting largely from vegetation changes brought on by extensive wildfires in 1910, 1919, and 1934 (Pengelly 1954, Leege 1968, Nyquist 1973). Increased forage, hunting restrictions, predator control and supplementing native herds with elk from Yellowstone Park, caused elk populations in the Clearwater and Spokane River drainages to increase between 1935 and 1965. Subsequently, increased access and habitat declines brought about by timber harvest activities, more lenient hunting seasons and bag limits, rising hunter numbers, and natural plant succession on winter ranges may have caused declines in elk populations up to 1975 (Leege 1976, Schlegel 1976). Since 1976 bulls-only hunting seasons have lead to increasing elk numbers and harvest across the state. However, increasing bull mortality has led to declining bull:cow ratios in many Idaho general season hunt units.

USFS elk management focuses on maintaining security and important habitats for huntable populations of elk. Large contiguous areas of wilderness in Idaho managed by the USFS provide elk habitat that is both remote and unthreatened by human development. Managed forests adjacent to wilderness areas provide elk habitats that overlap with both commercial and recreational forest use. Commercial logging, motorized recreation, camping, roaded access, and many other uses are found on managed forests lands in Idaho. Both wilderness and managed forests provide elk escape from human disturbance and hunting mortality, and the seasonal habitats elk need to grow and reproduce.

IDFG balances the biological requirements and potential of elk populations with the desires of elk hunters and interested publics. In 1993, IDFG sold more than 113,000 elk tags and more than 25,000 elk were harvested by hunters in Idaho. IDFG elk management focuses on elk populations, hunting experiences and strategies, existing conditions of habitats, their desired future condition, land ownership/use, and the interrelationship between elk habitats and elk populations. Different elk management strategies have different elk population and hunter recreation objectives monitored through IDFG elk population and elk hunter surveys.

These guidelines outline a standardized method for USFS management of elk habitat by a measure of **elk habitat effectiveness (EHE - the percentage of available habitat that is potentially usable by elk outside hunting seasons)**. EHE is based on managing the impacts of roads, livestock grazing, and forage and cover availability in summer (Leege 1984). The guidelines provide a method to (1) identify existing elk summer habitat quality, (2) evaluate the effects (improvement or degradation) a proposed activity might have on summer habitat quality, (3) specify which factor(s) are the primary agents affecting summer habitat quality, and (4) provide recommendations and methods for minimizing negative effects on elk summer habitat. The guidelines also use EHE assessment to monitor established management direction at the forest, ranger district, and project scales.

Research on the relationship among elk habitat condition, human access, hunter density, and elk hunting mortality rates has provided methods for estimating hunting season survival rates. (Leptich and Zager, 1991, Unsworth et al. 1993, Vales 1993). Increasing EV related to **hunter harvest**, rather than natural predation, disease, or other agents of natural mortality, **is the primary limiting factor** to bull survival (Unsworth et al. 1993, Gratson et al. 1997). These guidelines provide an outline for USFS and IDFG cooperative management of **elk vulnerability (EV - a measure of elk susceptibility to being killed during the hunting season).** The EV portion of these guidelines provides a method to sustain elk populations to provide a harvestable surplus of animals to meet the desires of the hunting public.

These guidelines assume the following:

1) The EHE model estimates the potential of elk habitat rather than actual elk use. Actual use is affected by factors other than habitat.

2) Displacement of elk from preferred habitats is often harmful to individual animals and the herd.

3) Optimum populations for both winter and summer elk habitats will seldom, if ever, be reached.

4) Elk populations provide and are influenced by hunting opportunity. Hunting influences population composition, mortality rates, numbers, habitat use, and behavior. If elk were not hunted, potential elk habitat use would be less affected by human activities than estimated using these guidelines.

5) Motorized vehicle use on roads or trails reduces summer habitat effectiveness and increases elk vulnerability.

6) Gates on roads are 70 percent effective in reducing motorized disturbance allowing for minimal administrative use and some trespass.

ELK ECOLOGY AND MANAGEMENT

<u>Elk Habitats</u>

Elk are tolerant of diverse environments as shown by their historic and widespread distribution and by their varied habitat use (Murie 1951, Thomas and Toweill 1982). However, elk do exhibit preferences for specific vegetation and terrain within areas they occupy. Protecting areas preferred by elk is an important aspect of preserving quality habitats. Detailed seasonal food habits are in Appendix A.

Spring Habitats (April-June)

Throughout spring, elk prefer open areas where grasses and forbs develop earlier and provide nutritious forage (Irwin and Peek 1983). Use is confined to winter ranges during early spring but progresses upward in elevation as the season advances (Dalke et al. 1965a). Although south exposures are used more frequently during April, all exposures are important during June. Thermal relief is not a major concern for elk because air temperatures are moderate during spring.

As elk change their diet from winter browse to green succulent material in spring, they develop an appetite for salt and utilize mineral licks when available. Dalke et al. (1965b) found in north-central Idaho that sodium seemed to be the element attracting elk and that elk made peak use of these licks during the second and third weeks of June. Although the question of how critically elk need supplemental salt remains unanswered, salt licks are heavily used when available.

Calving normally occurs between May 15 and June 15 with a peak in activity about June 1 (Moroz 1976, Schlegel 1976). Calving frequently occurs on secluded slopes of 15% or less on microsites which may have up to 40% slopes (Davis 1970, Roberts 1974). Typical calving habitat commonly contains open foraging areas adjacent to dense woody vegetation that may serve as hiding cover. Most cows appear to have traditional areas they return to each year at calving time. Elk may calve on or adjacent to winter ranges but at other times they migrate to summer range before calving--depending on the rate of snowmelt and plant development (Hershey and Leege 1982).

Summer Habitats (July-September)

The hot and dry climate in central Idaho during this period cause elk to shift their diet away from grasses and sedges toward the forbs that are found along streams and shady places where forage remains succulent. In Montana, Smith (1978) and Daneke (1980) suggested that succulence replaces availability as a dominant factor in forage selection during warm weather. Irwin and Peek (1983) found elk feeding in north- and east-facing clearcuts where forbs and shrubs were most succulent. Elk also feed in timbered areas during this period where forage is more succulent and nutritious than in openings (Holecheck et al. 1981). In the Selway drainage, Young and Robinette (1939) found that "elk sought out dense thickets or patches of timber for shade during the day" from mid-July until September 1. In the South Fork of the Clearwater River drainage, Hershey and Leege (1982) reported that old growth grand fir associated with poorly drained, cool, moist land types were important habitat components during late summer. Elk also selected for relatively level areas with less than 20% slope. Similar habitat preferences for a conifer overstory and gentle topography have also been reported for western Montana summer habitats (Scott 1978, Lehmkuhl 1981). Edgerton and McConnell (1976) and Pedersen et al. (1980) reported old growth conifer stands were highly preferred by elk on summer range in northeastern Oregon. Lyon (1979b) indicated that "Finally, the behavior response to hot dry summer weather in two different years can be taken as further evidence of the importance of cool moist habitat types to the overall integrity of elk summer ranges. Maintenance of body temperatures at some relatively constant level may be comparable to feeding as a daily preoccupation for elk." Forested areas may also provide some protection from biting insects (Collins and Urness 1982).

An important component of late summer-fall habitats are wallows used primarily by bull elk before and during the rutting season. These shallow pools are located in moist areas, often near the headwaters of small streams. Murie (1951) indicated they function to cool the body of the rutting bull and as an outlet for rutting behavior. Struhsaker (1967) speculated that "...the function of wallowing facilitates the location of bulls by one another."

Fall Habitats (October-December)

In north-central Idaho, elk use dense forests through the month of October and then gradually make greater use of openings for the remainder of the fall (Hershey and Leege 1982). Irwin and Peek (1983) reported that elk preferred dense pole timber for the entire fall period. In Montana, Lieb (1981) found that elk shifted to remote sites characterized by large expanses of escape cover during the fall hunting season. The use of heavy cover during October has been documented by others and may be associated with the need for security during hunting season and the breeding period (Altman 1952, Irwin and Peek 1979a). Hayes et al. (submitted) found that both cows and bulls selected for patches with greater hiding and thermal cover during fall hunting seasons. Bulls also selected patches that had lower open road densities in fall. A shift to openings during late fall may be in response to the green-up that sometimes occurs following rains or snow.

Winter Habitats (January-March)

After the rut, elk move to winter ranges in response to increasing snow depths at the higher elevations of summer and fall ranges. Elk winter ranges are commonly on south- and west-facing slopes and receive more direct sun and have shallower snow depths (McLean 1972, Leege and Hickey 1977). On winter ranges, elk limit their energy expense by limiting movement between feeding areas and using cover to maintain body temperatures (Beall 1974). This energy budgeting helps them survive winters feeding on browse and grasses but does not save enough energy to maintain body weight.

Disturbance of elk on winter ranges can cause high energy expenditures and increase the energy deficit of elk. Therefore, winter ranges are normally protected from human disturbance when they are occupied by elk. To increase both forage abundance and quality, winter ranges can be burned during spring and fall. Prescribed burning can maintain a diversity of habitats and conditions to provide choices under various climatological and snow conditions (Thomas et al. 1988). However, maintaining good summer range maximizes elk body condition prior to winter and may be more effective at increasing overwinter survival.

ELK POPULATION ECOLOGY

Elk calves are born in late May and early June to females usually >2 years old. Although some yearling females may breed and reproduce, the most productive years of a cow elk's life are between 4 to 12 years old (Flook 1970). Normal pregnancy rates during these years are above 90%. Female elk over 12 years old are not uncommon in populations with light or no hunting of cow elk. Cow elk older than 12 years show decreased pregnancy rates to 20% at 16-18 years (Greer 1966). Cow elk age and condition influence the timing and success of conception (Trainer 1971).

Newborn calves usually weigh between 23-45 pounds (Morrison et al. 1959). Calf weight and condition of the female at birth can affect elk calf survival (Taber 1976). Elk mortality rates are highest in calves less than 6 months old (Taber 1976) and predation, disease, and accidents are the primary causes. Predators of elk calves in Idaho may include coyotes, black bears, bobcats, and mountain lions. Schlegal (1986) found calf predation rates of 67%, 20%, [illegible], and 2% for black bears, mountain lions, unknown, and bobcats; respectively. Parasites and intraspecific competition/interaction were not major causes of mortality in elk calves.

The elk breeding season or rut begins in mid-September. Bull elk gather harems of females and defend and maintain them using vocalizations (bugling), antler sparring, and fighting. Larger and older bulls usually have larger harems and do most of the breeding. Antler size, bugling frequency and loudness, and body condition all help bulls maintain their territories and harems against other bulls (Geist 1982). These social displays and physical requirements help ensure breeding is done by healthy and mature males at the time of ovulation in females. Breeding by younger bulls may lower female pregnancy rates (Noyes et al. 1996), increase the proportion of calves born late (Hines and Lemos 1979), and subsequently heighten the risk of calf mortality during their first winter (Guinness 1978). Therefore, females bred later by younger bulls may indirectly increase the susceptibility of their calves to predation, decrease their conception rate because of poorer body condition during the next breeding season, and have a higher likelihood of aborting a fetus or dying because of poorer body condition the following winter. Noyes et al. (1996) suggested synchronous breeding and high pregnancy rates of cows can be maintained with a minimum of 18 3-year-old bulls or older per 100 cows.

Elk population management balances hunting season and over-wintering mortality with annual recruitment. Because the largest source of mortality on bull elk in hunted populations is hunter harvest (Unsworth et al. 1993), relative bull numbers are largely regulated by hunting. The largest proportion of hunting mortality is on bull elk during general season antlered hunts. Female elk mortality and harvest are normally regulated by more restrictive controlled hunts and/or short antlerless hunting seasons. A proportion of mature branch-antlered males is needed to contribute to the genetic survival of the species and maintain the health of the population by avoiding the indirect effects of delayed breeding by younger and/or fewer males. Hunter recreation opportunity and preferences are also important factors in determining elk population size/densities and the proportion of branch-antlered males maintained in an elk population (Vore and DeSimone 1991).

THE ROLE OF ELK IN THE FUNCTION OF ECOSYSTEMS

In traditional terms, elk are viewed as consumers of plants and as food for predators such as man. However, in ecological terms, elk affect and change the environment in both direct and indirect ways and at several scales of time and space. They can affect primary production, alter patch and successional dynamics, and affect abiotic disturbance such as fire (Hobbs 1996). Sustaining elk populations is important to maintaining ecological complexity, connectivity, and variation between and among ecological processes. Providing for elk habitats and maintaining a harvestable surplus of elk also provides for and sustains the biologic needs of other sympatric species. These species, which may include coyotes, wolverines, mountain lions, and bears, have spatial needs similar to elk and/or require the prey base and forage provided by elk. Similarly, neotropical birds forage and nest in the seasonal habitats used by elk and resident and anadromous fish require the forested and vegetated riparian areas used by elk for forage, travel, and cover. Elk are part of processes including but not limited to the pruning and cropping of vegetation; predation and decomposition; as hosts and vectors for parasites and diseases; and for converting and cycling vegetation, minerals, and nutrients. The importance and complexity of the relationships between elk and sustaining complex ecological systems cannot be underestimated or measured.

Elk also have a socio-economic connection to the human component of ecosystems because they are important to the recreation, spirit, and culture of human society. Hunting, viewing, and sustaining elk in Idaho is a community, state, national, and global resource. As a big game species, elk generate millions of dollars that benefit rural communities (Sorg and Nelson 1986). The revenue generated through the sale of elk tags and hunting licenses in Idaho supports the Idaho Department of Fish and Game's fish and wildlife management programs. These programs, as outlined in Section 36-103 of the Idaho Code, allow the Department to preserve, protect, and perpetuate wildlife populations in the state of Idaho and provide "...continued supplies of such wildlife for hunting, fishing, and trapping." In 1995, over 60% of the IDFG revenue generated by elk tag sales came from nonresident elk hunters. These nonresident hunters and the many residents who hunt and view elk and elk habitats provided an estimated $7.6 million to Idaho's economy in 1983 (Sorg and Nelson 1983). The USFS, a federal agency funded by national tax revenues, is legally obligated to manage for elk populations and habitats as part of its multiple use mission on federally-owned lands. Big game hunting recreation provided by USFS lands in the United States provides an estimated $438 million [American Sportfishing Association 1996] to the rural and state economies where these lands are located. In Idaho in 1994, USFS lands provided habitat for approximately 66% of central Idaho's elk population and 500,000 big game hunting days of recreation (IDFG files). This generated $22.2 million in retail sales, $40.0 million in economic output, and supported 632 full time equivalent jobs in Idaho (American Sportfishing Association 1996).

ELK MANAGEMENT

Differentiating Elk Habitat Effectiveness and Elk Vulnerability

Managing for public desires and sustaining elk habitats and populations require that the USFS and IDFG simultaneously measure effectiveness of elk habitats and the vulnerability of elk populations. These measures can be used to regulate the limits of change to EHE and EV through management of human access, elk hunters, and land management activities.

EV and EHE are separate issues. Managing human effects on elk habitat is an element common to both issues. The EHE model forecasts potential effectiveness in habitats used by elk for calving, nursing, security, and gaining body condition (Leege 1984). EHE predicts the change in potential effectiveness of habitats for summer elk use. EHE measures apply only during the summer (May 1 - beginning of any elk rifle hunting season). The percentage value for potential elk use in EHE refers only to habitat quality and not to actual elk use. For example, a potential elk use value of 43% indicates that an area might support 43% as many elk as it could if all habitat factors were optimal. Percentages can be converted to an elk number by assuming specific potential elk densities occur on certain areas. For example, data may indicate that potential elk density is 1 elk per 40 acres. If the evaluation procedure calculates the habitat to be at 43% of potential elk use, then the area has the capability to support 0.43 elk per 40 acres.

EV measures predict elk mortality rates as a function of hunter and motorized route densities during any rifle hunting season. The EV model helps identify the different balances between hunter and motorized route densities necessary to meet elk goals and objectives relating to hunting season survival. Managing EV requires the IDFG and USFS share management responsibility to achieve a publicly endorsed and agreed upon balance between hunter and motorized route densities. Current EV measures apply only during elk rifle seasons. As EV measures are refined or as technology changes, management of EV may extend to other types of hunting seasons, weapons, and access management.

Human Access Management

Access management can either directly restrict the number of forest users and hunter densities/numbers or indirectly restrict the type of human access to the forest landscape. The preferred methods for managing the effects of human access on EHE and EV, are indirect and prescribe the types of human access. Indirectly restricting the type of access management provides for the multiple use of forest lands as well as a variety of human access opportunities needed to meet EHE and EV requirements.

There is a general gradient of human access impacts on elk habitats. Beginning with the highest EHE and lowest EV values to the lowest EHE and highest EV values, the gradient goes from: roadless elk habitats, then to habitats with constructed or evolved roads and trails restricting all motorized access, then to habitats with some motorized access restrictions (restricting vehicle type and/or season of use) and then finally to habitats with unrestricted motorized use of roads and trails. Roads and trails that make elk habitats more accessible to nonmotorized human travel such as mountain bikes, hiking, and pack stock do decrease EHE and increase EV over areas without road and trail development. However, the measure and mitigation of nonmotorized access effects is difficult to determine and has not been evaluated. Therefore, the gradient and spectrum of EV, EHE, and human access conditions is most simply and logically divided between motorized and nonmotorized access.

For consistent access management we defined open and closed roads using the USFS/USFWS grizzly bear access management guide (Interagency Grizzly Bear Committee 1994). Open roads are any established or evolved roadways, two-tracks (excluding timber skid trails), or trails which are unrestricted to public use by any class of motorized vehicle. Closed roads are any established or evolved roadways, two-tracks (excluding timber skid trails), or trails which are closed physically (gates, barriers, partial obliteration, etc.) and administratively to public use by any class of motorized vehicle.

In managing human access as it affects EHE and EV, the USFS and IDFG must match the existing conditions of elk habitats and populations with the appropriate scales of monitoring and management. To avoid fragmented management and cumulative effects on access, elk populations, and elk hunting recreation, we recommend USFS management areas and IDFG game management units (GMU) coincide. These corresponding landscapes are not only biologically meaningful but they help simplify rules and regulations. Area closures and access prescriptions within these overlapping landscapes are preferred over individual road and trail prescriptions to sustain elk hunting recreation. This helps sustain and diversify hunter, recreation, and access opportunities.

Coordinating Land Management Activities with Elk Habitat Preferences

The major land use activity affecting summer elk habitat on public lands in northern and central Idaho is timber harvesting and the road construction associated with it. With proper planning, timber harvest can usually be conducted with minimal detrimental impacts on elk habitats and populations--in some cases, harvest can have positive effects. However, access associated with timber harvest has negative impacts that are impossible to completely mitigate unless temporary roads are built and then obliterated. We provide rationale and recommendations for making timber and elk population and habitat management as compatible as possible.

Timber Harvest

Logging has the potential for altering the amount and distribution of cover and forage areas and changing elk movements, distribution, and habitat utilization. In addition to vegetation changes caused by timber removal, it is necessary to consider the effects of logging slash, and the timing, pattern, and duration of logging activity.

Natural forest stands commonly have micro openings in the canopy that allow sunlight needed for growth of elk forage. In these situations, creation of additional openings through logging may not provide forage benefits needed by elk (Marcum 1976, 1979; Hershey and Leege 1982). However, beneficial forage can result when logging in elk habitats that have a dense canopy and a limited understory of shrubs, grasses and forbs.

Elk may make heavy use of clearcuts on summer ranges (Irwin 1978, Nelson et al. 1981, Hershey and Leege 1982). Irwin (1976) and Irwin and Peek (1979b) reported that clearcut sites produced the most palatable elk forage and partial cuts the least in the cedar/ hemlock zone. Edgerton and McConnell (1976) found that partial cut stands provided neither optimal forage nor cover during the summer period in northeastern Oregon. Partial cuts also have the disadvantage of requiring more timber harvest entries and thus cause more disturbance to elk in the area.

Lyon (1976) reported heavier elk use in 40-acre openings as compared to larger ones. Irwin and Peek (1983) indicated that 35- to 50-acre clearcuts were used most. Reynolds (1962, 1966) found in Arizona that forage sites created by harvesting timber had decreased elk use at distances beyond 600 feet from the edge of cover. Hershey and Leege (1982) reported that aerially-observed elk in northern Idaho were usually within 300 feet of cover when using clearcuts during daylight hours.

The debris and slash byproduct of timber harvest has the potential to affect elk behavior and movement in both the cut area and adjoining uncut area. Lyon (1976) stated that elk use in and adjacent to cutting units diminished when slash and other down material exceeded 1.5 feet in depth. The method of slash disposal has a great effect on elk forage production after treatment. On many habitat types in northern Idaho broadcast fall burning favors the establishment of forage plants preferred by elk (Cholewa 1977, Wittinger et al.1977).

Timber harvest activities can disrupt elk migrations and displace elk for a distance of 0.5 to 4 miles away from the activity area (Leege 1976, Lyon 1975, 1979b; Long et al. 1981; Hershey and Leege 1982). Displaced animals often remain within undisturbed portions of their traditional home ranges (Lieb 1981, Hershey and Leege 1982). Distance of movement is reduced if elk can put a topographical barrier between themselves and the disturbance. Topography appears more effective than undisturbed forest vegetation for reducing the effect of disturbance (Lyon 1979b).

The duration of disturbance in a logged area appears to affect the time it takes for elk to reoccupy the area after disturbance ceases. In several logging sales where activity was no longer than one operating season, elk returned soon after removal of people and machinery (Lyon 1979b, Hershey and Leege 1982). However, in a logging sale which had five consecutive years of disturbance, it took four additional years after complete road closures to get the same amount of elk use as what existed prior to logging (Lyon 1979b). Results from these studies should not be interpreted to mean that all elk leave an area when disturbed. Individuals often remain in close proximity or even be attracted to logging operations.

Recommendations

1) Silvicultural methods that change the vegetation so that it no longer meets the definition of hiding cover (Appendix E) should be confined to an area with a maximum width of 1,000 feet and should be bordered on all sides by cover of not less than 800 feet.

2) Maintain slash depth at less than 1.5 feet to minimize impact on elk movements, distribution, and habitat use.

3) When promoting increases in shrub cover and/or forage using burning and silviculture methods, do so without new road construction.

4) Plan timber sales so maximum duration of disturbance in any one area is two years in succession and the period of non-disturbance after post-sale activities is at least 3 years. Eliminate random logging and disturbance over the entire sale area. Use smaller sales or sequencing of larger sales through contract stipulations.

5) When feasible, refrain from road construction and logging in areas when elk would normally be using them. For example, do not log important summer habitat during summer if a viable option is to log during the winter.

6) If summer logging is planned on elk summer range, provide adjacent security areas at least as large as the areas being disturbed to provide elk security during periods of timber harvest and/or road building activity. This may be accomplished by scheduling of sale subdivisions so that one or more

subdivision is closed to all human activity including log hauling at one time. Try to provide a ridge line between disturbed and security areas. It is preferred to have more than one security area adjacent to the sale area.

7) When feasible, utilize alternative logging systems such as log forwarders, helicopter, or long span skyline to reduce the amount of road construction and reconstruction required.

8) Protect major elk travel routes with buffer strips on either side for at least two sight distances (see Appendix E).

Access

In hunted elk populations, human disturbance causes elk to move from preferred habitats to less preferred habitats in summer (Marcum 1976 and Lyon 1979). Roads constructed through elk habitat and left open for public use with motorized vehicles have a significant influence on animals using that area. Such adverse effects include displacing elk from preferred habitats because of increased disturbance and increased elk vulnerability.

Open roads substantially reduce elk use in adjacent habitat (Hershey and Leege 1976, Marcum 1976, Perry and Overly 1976, Pedersen 1979, Lyon and Jensen 1980, and Lyon 1979a, 1982). Roads themselves do not reduce elk use. Closed roads are often preferred by elk as travelways (Marcum 1976). The amount of vehicle traffic is a factor determining how much elk use will occur adjacent to roads. Heavily-used forest roads have a much greater effect on elk use of adjacent habitat than do primitive roads (Marcum 1976, Perry and Overly 1976, Long et al. 1981). There is some indication that elk respond less to constant non-stopping vehicular traffic than to slow vehicles which periodically stop and have human activity associated with them (Burbridge and Neff 1976, Ward 1976). In addition to disturbance caused by traffic, roads remove about 5 acres of productive habitat per mile if the surface is such that vegetation is prohibited from growing.

In Idaho, human access into elk habitats has been fostered primarily by road building associated with timber harvest (Thiessen 1976, Leege 1976b, Christensen et al. 1991, Christensen et al. 1993) and the development and use of off-highway vehicles on roads and trails closed to or unusable by highway vehicles. Although elk densities adjacent to open roads may be reduced, higher hunter densities can increase elk harvest rates (Hershey and Leege 1976, Daneke 1980). Daneke reported that almost twice as many elk were killed within a quarter mile of open roads as any subsequent quarter mile interval. However, elk densities and hunter success were lowest in the quarter mile adjacent to open roads. Leckenby et al. (1991) indicated increased hunting pressure, loss of hiding cover, and increases in road access in Oregon lowered bull escapement in hunting regions.

Leege (1976b) and Schlegel (1976) suggested that the decline of elk in north-central Idaho was partially due to increased access to elk summer range by numerous logging roads which made elk more vulnerable to hunters. Increases in elk vulnerability to harvest by hunters has been associated with higher open road densities during hunting seasons (Leptich and Zager 1991, Unsworth and Kuck 1991, Unsworth et al. 1993, Gratson et al. 1997). Bull elk mortality rates were 35-37% lower in areas with 0.5 mi/mi^2 open roads than in adjacent areas with 4 mi/mi^2 open roads (Unsworth and Kuck 1991, Unsworth et al. 1993). In northern Idaho, elk survival rates were 15% higher in areas where open road densities were reduced from 5.3 mi/mi^2 to 2.6 mi/mi^2 through hunting season road closures than in adjoining areas with 5.9 mi/mi^2 total roads and 4.5 mi/mi^2 open roads (Leptich and Zager 1991, 1994). Similarly, bull elk survival rates increased 15-20% in areas where open road densities were reduced from 4.0 mi/mi^2 to 0.9 mi/mi^2 through hunting season road closures. (Gratson et al. 1997).

Recommendations

1) Avoid construction of roads and trails.

2) When major elk trails are bisected by roads, crossings should be provided across cut-and-fill slopes so they do not exceed natural gradients. This is especially necessary when cut slopes are over 8 feet high and/or have a greater than 3/4 to 1 slope.

3) Tree and shrub removal along roadsides should not extend any farther away from road edge than necessary.

4) When continuous slash depths adjacent to roads in cleared rights-of-way exceed 1-1/2 feet in depth, openings 16-feet wide through the slash at 200 foot intervals are recommended, especially on ridges and trail crossings.

5) Maintain a minimum 300 foot buffer strip that qualifies as hiding cover between open forest roads and openings which serve as elk use areas.

6) Roads that are to remain open should avoid saddles, meadows, riparian areas, and ridge tops as these are usually major elk use areas.

7) Design roads so they can be easily and effectively closed (either permanently or temporarily) at low cost. In new road construction include low standard design and use roads classified as temporary to prevent establishing use during activity.

8) Install gates at onset of road building activity to prevent public use patterns from becoming established.

9) When logging activity and/or road construction is occurring, gates should be closed and locked after passage of every vehicle to prevent established use of new roads and reduce disturbance on existing roads.

10) For large road systems consider blocking side roads based on subdivision boundary and sequential scheduling.

11) Inform the public using signs and all other media types, about the reasons and seasons of access closures.

12) Replace gates with permanent barriers after logging activity where maximum elk security and habitat use is desired.

13) Revegetate the entire road driving surface as well as cut-and-fill slopes on permanently closed roads using native species of shrubs, grasses, and forbs. Promote road revegetation by native alders (<u>Alnus</u> spp.) and thorny species that provide more of a barrier to human access.

14) Area closures are preferred when terrain features and cover characteristics do not favor the effective management of motorized vehicles with gates or barriers and to prevent pioneering of roads and trails.

15) Roads should be completely or partially obliterated if future entry is not desired (i.e. temporary roads). This reduces both motorized and non-motorized access. If obliteration is not an option, placing forest debris along the roadway (logs, rocks, etc.) should be considered. Consider future transportation needs, road maintenance, fire control, and fisheries/watershed concerns in road obliteration.

16) If roads are gated to all motorized use for one month during a four-month summer use period, assume they are 1/4 of 70%, or 17% effective. A two-month closure would be 34% effective. If roads are closed completely with jersey barriers, immoveable boulders, or bridge removals, disturbance is reduced by 90%.

17) Areas more than 500 feet from cover receive approximately 25% of normal elk use unless there are no open roads in or adjacent to the opening. natural meadows?

Livestock Grazing

Numerous studies indicate that livestock sometimes compete with elk for forage and that a social interaction occurs (Nelson 1982). Nelson and Burnell (1976) found that elk moved to new areas when cattle were placed on the range. Lieb (1981) reported that both cattle and horses displaced elk when introduced onto their ranges. However, sometimes elk returned after a few days and continued to use the area despite the presence of livestock. In north-central Idaho, Dalke et al. (1965a) found a "definite dispersion" of elk when cattle were moved onto the Coolwater Ridge Study Area in late June. Elk moved away from open areas preferred by cattle and into tall dense shrubs. In Oregon, Skoviin et al. (1968) indicated that elk use declined with onset of cattle grazing. In Wyoming, Long, et al. (1981) reported that once cattle entered an area, elk use declined. In Montana, Lonner (1977) and Mackie (1970) noted that the movement of cattle into areas being used by elk caused displacement of elk into areas where cattle had not been. These studies also indicated that as density of cattle or livestock increased, their effect on the elk also increased.

Riparian habitat is highly preferred by elk during summer months (Pedersen et al. 1980) and forage competition between livestock and elk can occur in moist riparian areas in late summer (Lieb 1981).

<u>Recommendations</u>

1) Examine potential forage conflicts on ranges commonly used by elk and livestock to determine if big game carrying capacity is being reduced.

Special Considerations in Managing EHE

1) Do not permit activities such as timber harvest, livestock grazing, or road building on established calving and rearing areas during the period May 1 through July 15.

2) Identify and protect special habitat components like riparian areas, natural licks, wallows, calving and other high-use areas by buffering them from human disturbance and activity and livestock grazing.

3) Elk analysis areas (EAA's) that have EHE values above objective should not be used to compensate for the effects of lowering EHE in adjacent EAA's that are at or below EHE objectives.

Elk Vulnerability Management

Thomas (1991), listed 10 factors influencing EV (Figure 1). Two factors, hunter density and hunter success, directly influence EV. The other factors act to change hunter density or success and indirectly affect vulnerability. The effect of each factor on EV depends on other factors.

Increased harvest rates of bulls have resulted from the improved technology and skill of hunters (Henckel 1991). Elk hunting rifles shoot farther and are more powerful than they once were. Bugling for bulls during the rut has become more popular as hunters learn the skills needed to be successful (Loftus 1991). Archery and muzzleloader elk hunting is more popular and the equipment has improved (Cada 1991). Hunters can access remote hunting areas with the advent of motorcycles, off-highway vehicles (OHV's), and mountain bikes (Henckel 1991). Improved technology in clothing has made it easier to pack into and remain in previously remote and secure areas.

name one such!

The effects of hunting season length and timing are complicated. IDFG and other state management agencies have found that shorter seasons may result in higher hunter success and/or hunter densities. This may lower the ability of elk and deer to avoid hunters. Longer seasons may also result in more elk killed, but this is not always true. In general, hunting seasons during the rut result in more bulls killed. Seasons with snow on the ground can also result in more elk killed.

Antler point restrictions are usually a temporary solution to EV concerns. Restrictions on sex and antler points of harvestable elk reduce vulnerability of the protected sex-age class. Antler point restrictions can be used to broaden the age structure of populations. For example, spike-only hunts in Idaho have resulted in increased proportions of older age classes of bulls and increased bull:cow ratios (Hughbanks 1993). Spike-only general seasons together with branch-antlered bull controlled-hunts can result in higher bull:cow ratios and an older age structure of bulls (Vore and DeSimone 1991). Branch-antlered only and 4-point or better seasons can also improve bull:cow ratios (Carpenter 1991).

Rougher and more diverse terrain (high aspect variability) may reduce local hunter density and reduce elk/hunter encounter rates than in flatter areas. Aspect variability was a significant predictor of EV along with hunter density and open

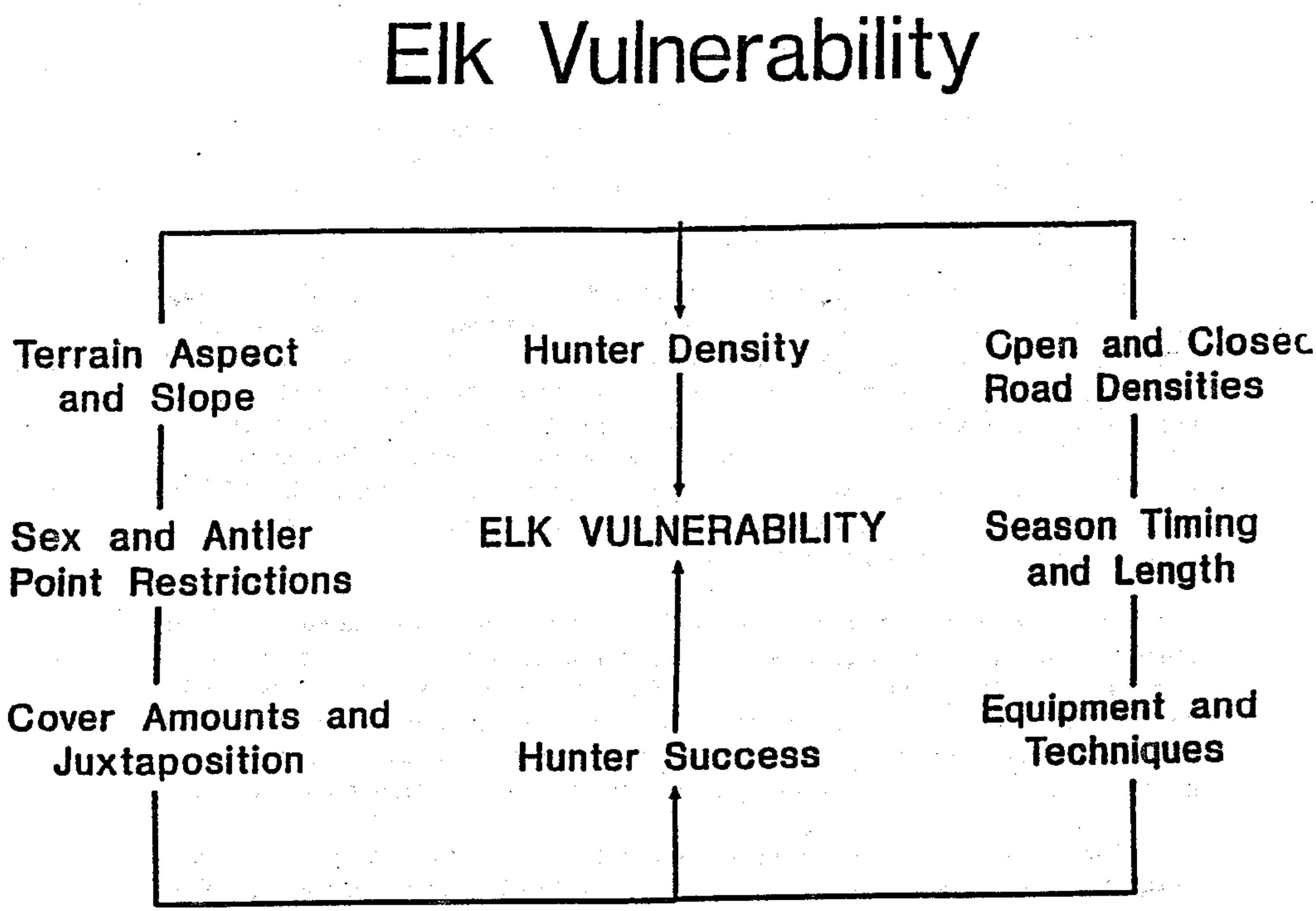

Figure 1. Factors influencing elk vulnerability (modified from Thomas 1991). Hunter density and success directly affect vulnerability; other factors act through density or success to indirectly affect vulnerability.

road densities in central Idaho (Unsworth et al. 1993). In general, the higher the aspect variability in bull elk home ranges, the greater the survival of bull elk during hunting seasons.

In general, EV increases with decreasing cover amounts and patch (or block) sizes. Timber harvest and fire can eliminate hiding cover used by elk during the hunting season (Peek 1976). Elk may be more vulnerable to hunting when only relatively small patches of timber are available because hunters may concentrate their search in those areas (Unsworth and Kuck 1991). Hillis et al. (1991) suggested elk survival could be increased by leaving nonlinear blocks of hiding cover of at least 250 acres and at least 0.5 mi from open roads after timber harvest.

Roads and other constructed or evolved human access routes increase EV by making elk habitat more accessible. Roading and trail development increases hunter access into formerly remote elk habitat (Thiessen 1976, Leege 1976b, Christensen et al. 1991, Christensen et al. 1993). Abandoned and unrestricted roads and trails are used by motorcycle and off-highway vehicle users. Restricted and barriered roads and trails reduce motorized access, but can lead to an overall increase in human access through foot, bicycle, and horseback use. These effects have not been measured.

Under the same environmental conditions, EV will be higher where there are more hunters (Christensen et al. 1991, Unsworth et al. 1993, Vales et al. 1991). For any given environmental circumstances, there is a point at which the only management option left for directly reducing EV is reducing hunter density. This point can occur before or after all other means of indirectly reducing hunter density or success are exhausted.

Recommendations

1) Project, site specific, or other management activities at scales smaller than a GMU that affect the EV components of access and hunter numbers should be considered in the context of GMU level trends and objectives.

2) Effective project level access management should consider where the most gains in EV can be made. For example, closing 10 miles of roads during hunting seasons in an area where road densities are high (>4 mi/mi^2) may not decrease EV as much as closing 5 miles of road where road densities are low (<1 mi/mi^2).

3) EV access and hunter management should sustain the type of hunting recreation provided by existing or desired conditions within a GMU.

4) Avoid overlapping potentially conflicting hunting recreation types (motorized and nonmotorized) within a watershed or landscape or fragmenting existing recreation opportunities.

5) Develop and use a GIS-based analysis of roads at the GMU scale to develop a landscape picture of access variables (roads, trails, motorized, nonmotorized) during hunting season.

6) Hunting season and access management changes may not immediately influence elk and hunter survey statistics. Emphasis should be on managing trends and 5-year averages of objectives through access and hunter management. Year to year changes are not recommended unless they constitute an incremental phasing-in process.

7) At the GMU level, public involvement helps determine what balance of open roads and hunter numbers are incorporated into USFS and IDFG plans to achieve the hunting recreation experiences that are desired and sustainable.

8) USFS access management should consider total and open road densities during hunting seasons and road obliteration in the context of the road systems needed for timber harvest and other recreational needs.

9) IDFG hunter density management within GMUs should consider management of hunting seasons, types of seasons, or the number of hunters.

10) USFS and IDFG implementation of road and hunter density management to achieve EV objectives can occur at different scales, simultaneously, or independently but should affect EV trends in the same way.

Managing EHE and EV on Mixed Ownerships

If significant portions of GMUs are of mixed ownership, efforts to develop cooperative access management agreements should be a priority. Potlatch Corporation, Nez Perce Tribe, Idaho Department of Lands, Bureau of Land Management, and U.S. Army Corps of Engineers are some of the primary land and elk habitat managers. Cooperative agreements should use these guidelines for EHE and EV management. Road and trail management agreements should be legally enforced by one or more cooperators. Road and trail database validation prior to implementing access management measures across mixed ownerships is important. Roads and trails within mixed land ownerships should be considered open and unrestricted unless road and trail databases can be validated and maintained.

Recommendation

1) Elk habitat in intermingled ownerships requires full consideration and disclosure of the site specific and cumulative effects on EHE and EV.

Monitoring Elk Populations and Habitats Using Adaptive Management

The effectiveness of managing EV is evaluated by monitoring wintering elk populations and elk harvest during hunting seasons using IDFG elk sightability surveys and big game harvest telephone surveys, respectively. Using watershed and project-specific efforts, the USFS and IDFG seek to provide an even spatial distribution of EV within a GMU while fulfilling EV planning level goals and objectives at USFS management area and IDFG GMU scales. Annual USFS and IDFG monitoring will ensure yearly review and measure of EV trends.

USFS and IDFG management of EV is an adaptive process that requires modification (Walters 1986). Management designs of the IDFG and USFS will compare the effectiveness of different EV management strategies (combinations of road densities and hunter densities) in different GMUs within an adaptive management framework. The current model includes only open road density and is a modified version of Unsworth et al. (1993) that excludes terrain aspect heterogeneity. The future evolution of the model will also include incorporating cover variables (Leptich and Zager 1994, Gratson et al. 1997). Recent research has focused on the effect of closing roads during the hunting seasons. The results of both management applications of EV and EV research should be incorporated into these guidelines (Gratson et al. 1994, Leptich and Zager 1994).

Many questions exist about the sensitivity and measures of the EHE model. Standardizing the use of the EHE model through boundary and coefficient definition and connecting these definitions to standard databases will allow EHE management to be adaptive. Measuring existing conditions in each EAA and monitoring their trends will allow elk habitat management to connect to elk population trends and management. Monitoring both population management and EHE variables in relation to management changes will allow hypothesis testing of the EHE model in the context of adaptive management. It is extremely important that the implementation of these guidelines is consistent across forest, district, region, agency, and other boundaries.

Evaluating the Effects of Management Activities on Elk

Road Effects

The most important factor usually affecting actual use of habitat by elk is disturbance caused by people. Most disturbances originate from roads, both from construction and subsequent use. Degree of disturbance is related to amount of traffic, season of traffic, type of traffic, and amount of buffer available to separate the disturbance from elk.

Lyon (1982, 1983) used several different road density models to estimate elk use in northern Idaho and found that a curve developed with data from Burdette Creek and Deer Creek in Montana proved most effective (Figure 2). This curve represents a main road with some vegetation adjacent to it and is used as the standard road to which other types are compared (Table 1). To clarify Table 1, the value of .50 next to open secondary road through hiding cover indicates that 1 mile of that type of road would be the equivalent of .50 mile of standard road. When doing EHE computations, all road types need to be converted to standard roads so that Figure 2 can be used. To arrive at equivalent values for other types of roads, information was used from Perry and Overly (1976) and Lyon (1979a); collective judgement was used for situations where no data were available.

The Table 1 coefficients reflect 4 refinements from Leege (1984): 1) elimination of hunting season coefficients, 2) standardized definitions for roads (RMAS - USFS road management system database), 3) no differentiation between motorized vehicle types, and 4) no differences based on estimated daily traffic levels during elk use periods. Administrative use along with the trespass through or around gates is the reason why gates are not as effective as barriers in the Table. Vegetation must be dense enough to qualify as hiding cover within 300 feet on both sides of road or it is classified as open.

Different types of road closures have varying degrees of effect on lessening impacts on elk (Table 1). For making computations, we assumed gates were 70% effective in reducing motorized disturbance if there was a minimal level of administrative activity and some trespass. If major activity, such as road construction or logging, occurs behind the gate, then the gate has no effect in reducing disturbance. If roads are gated to all motorized use for 1 month of a 6-month summer use period assume they are at least 1/6 of 70%, or 12% effective. A two-month closure would be 24% effective. If roads are closed completely with barriers such as tank traps, immovable boulders, or bridge removals, disturbance is reduced by 90%. These figures should be validated by road closure monitoring. Even after complete road closures, elk may not resume their normal use of an area

Table 1. Equivalent mileage of standard road for 1 mile of various types of roads, road closures, and vegetation adjacent to open roads, after Leege (1984).

Road type	Road status	Vegetation adjacent[1]	Open[1]
Arterial/collector roads	closed to motor vehicles (w/gate[2])	0.24	0.36
	closed to motor vehicles (w/barrier[3])	0.08	0.12
	closed to motor vehicles (obliterated)	0	0
	open to motor vehicles	0.80	1.20
Local roads	closed to motor vehicles (w/gate[2])	0.15	0.27
	closed to motor vehicles (w/barrier[3])	0.05	0.09
	closed to motor vehicles (obliterated)	0	0
	open to motor vehicles	0.50	0.90
Temporary roads and system trails	closed to motor vehicles (w/gate[2])	0.01	0.02
	closed to motor vehicles (w/barrier[3])	0.01	0.01
	closed to motor vehicles (obliterated)	0	0
	open to motor vehicles	0.03	0.07

[1]These values derived from data reported by Perry and Overly (1976), Thomas et al. (1979) and Lyon (1979a, 1982), and by extrapolation to situations for which no data were available.
[2]Assume it allows for administrative travel.
[3]Assume it is impassable to any motorized vehicle and has no administrative use.

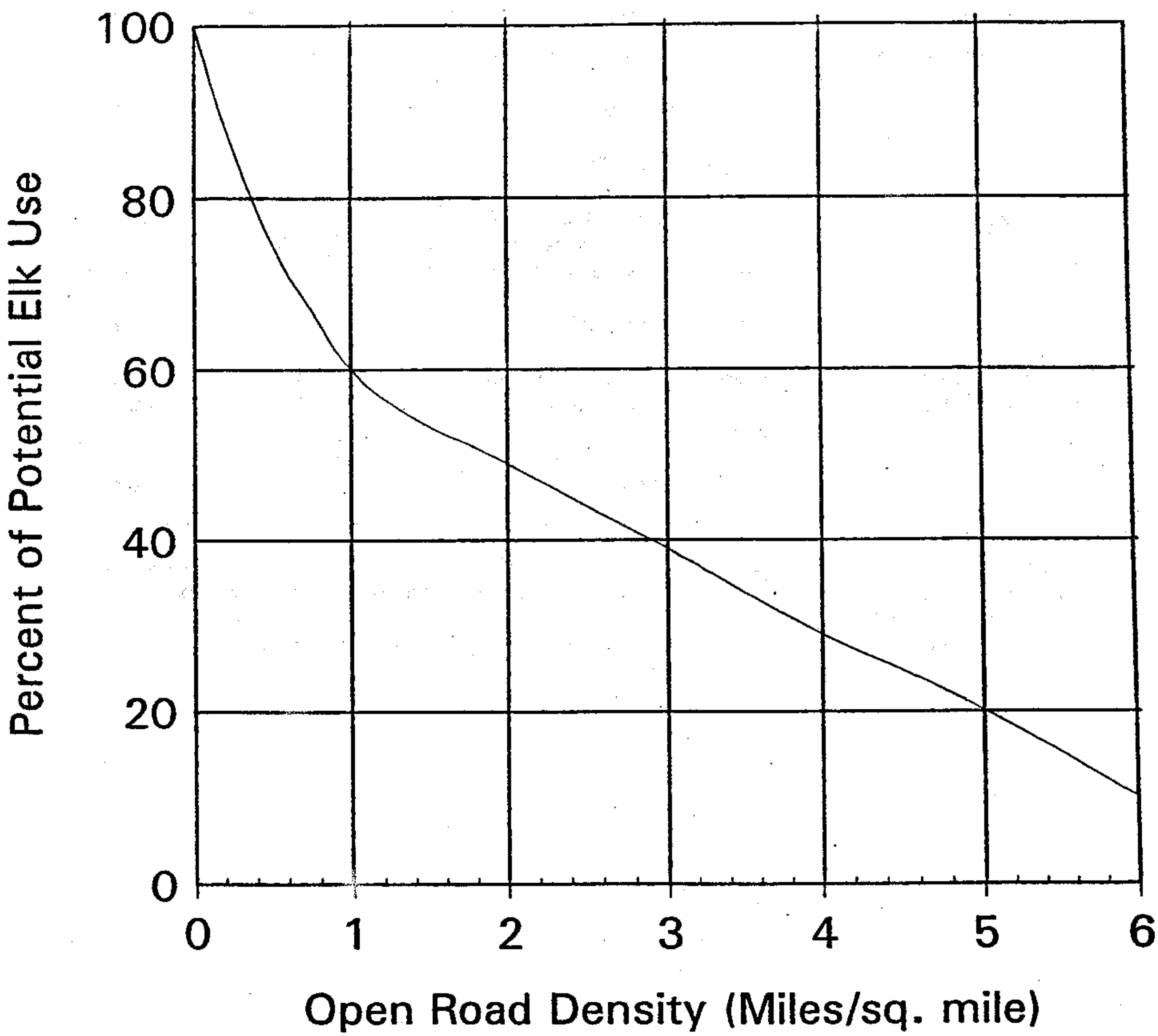

Figure 2. Relationship between miles of open main road per square mile and potential elk use (from Lyon, 1983). This curve is used as a standard against which other road types are compared (Table 1).

for several years--the exact time influenced by the number of years the habitat was disturbed. In fact, elk use may never return to the level that existed prior to road construction since even closed roads provide improved access for hikers, trail bikes, and livestock.

Livestock Effects

Painter (1980) summarized 11 studies which showed the relationship between cattle density and elk use. The curve showing that relationship (Figure 3) was derived from an equation presented by Painter. All 11 studies were not done in comparable ways. However, in all cases, cattle density was known and percent elk use, before and after cattle entry, was obtained. It has also been demonstrated that elk distribution is influenced by domestic sheep (Nelson 1982) and horses (Schlegel, unpublished data), but cause-and-effect curves have not been developed. Assume for computation purposes that horses and sheep numbers can be converted to cattle equivalents and the effect estimated from Figure 3. Use the standard conversion procedure which is based on forage consumption; one cattle equivalent equals: 1 cow with calf, 0.8 horse, or 5 sheep.

Effects To Forage, Security Areas

The size and interspersion of hiding cover, thermal cover, forage and security areas within an EAA can be evaluated. When these factors are found to be at less than optimal levels, additional reductions in potential elk use can be assessed in relation to general descriptions in Table 2.

Cover:forage ratios have been widely used as an index of elk habitat quality since they were proposed by Black et al. (1976) for the Blue Mountains. However, Lyon (1984) concluded that habitat relationships for the summer period are far more complex than can be defined by a cover:forage ratio, especially since those habitat needs change drastically during that period. Hiding and thermal cover are not as important on elk summer range as implied in Leege (1984) (Christensen et al. 1993). Because the cover:forage ratio per se is not included in these guidelines as a factor influencing potential elk use, identification of specific forage:cover ratios for elk summer ranges are not recommended nor should detailed comparisons of cover and cover:forage ratios be done in EHE analysis. However, maintenance of cover size, amounts, connectivity related to elk use patterns, and elk security are important (Table 2). Summer cover blocks can also provide for fall hunting season security areas, connecting EHE and EV management (Christensen et al. 1993).

Table 2. Effects of size and distribution of hiding and thermal cover on elk use.

Size and distribution of hiding and thermal cover	% reduction in elk habitat effectiveness
At least 40% of EAA qualifies as hiding cover. At least 25% of each quadrant qualifies as hiding cover.	0
At least 30% of EAA qualifies as hiding cover. At least 10% qualifies as thermal cover. At least 20% of each quadrant qualifies as cover.	10
At least 20% of EAA qualifies as hiding cover. At least 5% qualifies as thermal cover. At least 15% of each quadrant qualifies as cover.	20
Size and distribution of forage areas	
All openings less than 1,000 ft. wide. At least 800 ft. of cover between all openings. Forage appears adequate and present in all quadrants.	0
About 7% of usable acres in EAA are more than 500 ft. from cover; or less than adequate amounts of cover between 50% or more of openings; or forage adequate but present in only 2 quadrants.	5
About 13% of usable acres in EAA are more than 500 ft. from cover; or less than adequate amounts of cover between 100% or more of openings; or forage not adequate.	10

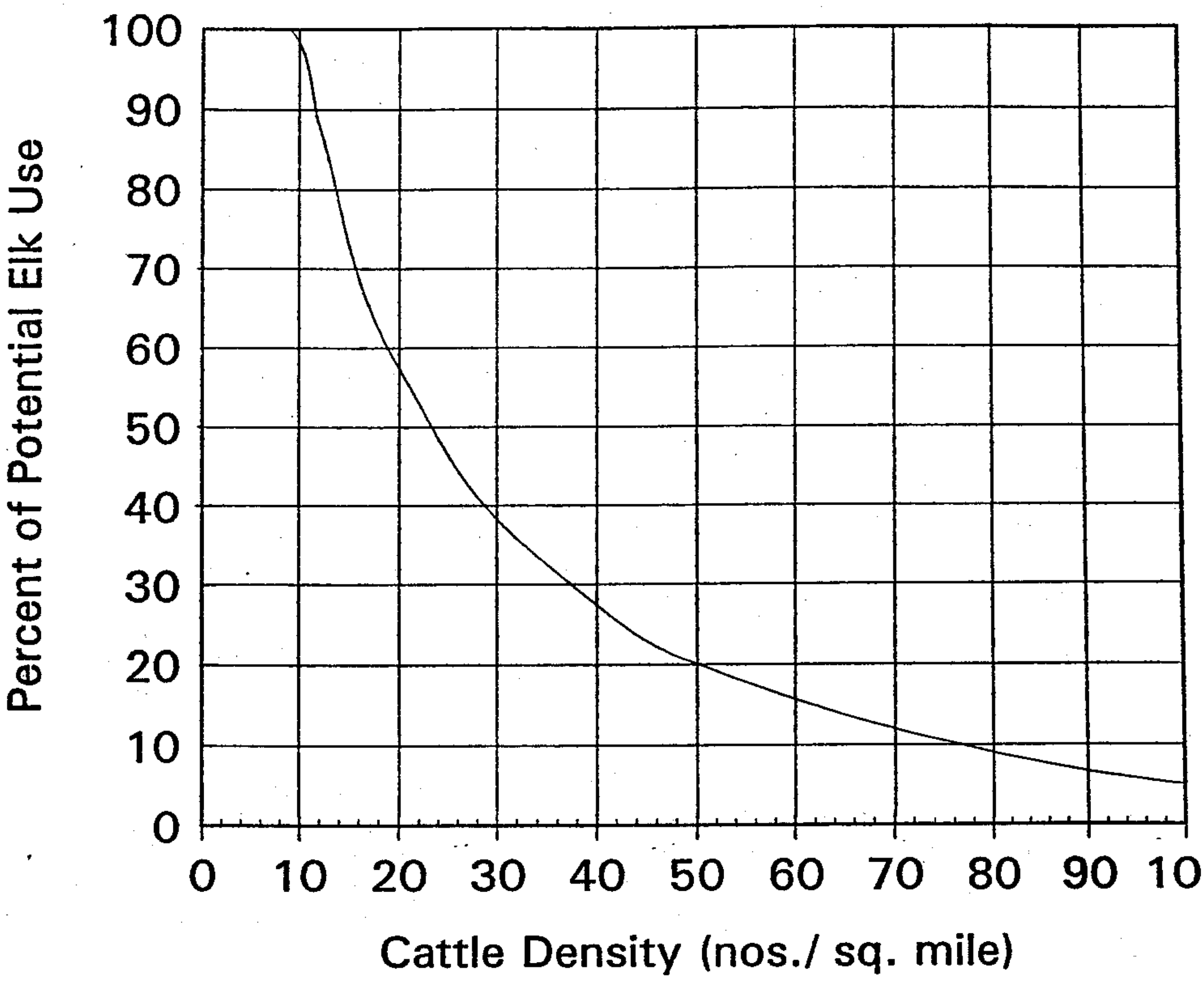

Figure 3. Relationship between cattle equivalents per square mile and potential elk use (from Painer, 1980)

To manage cover, timber stand exam information or forest inventory plots from the forest-wide vegetation database should be used. Six hiding cover classes should be used in cover analysis: 0%, 15% (range 1-29%), 40% (range 30-49%), 60% (range 50-69%), 80% (range 70-89%), and 100% (range 90-100%). A weighted approach to calculate acres of hiding cover based on average hiding cover value should be used in EHE analysis.

Cover can be further divided into hiding cover and thermal cover (Appendix B). O'Neil (1981) evaluated various methods for determining cover using aerial photos, maps and ground surveys and recommended that photo interpretation (P.I.) maps be used for cover determination. P.I. maps are based on differences in visual appearance of vegetation on aerial photographs and the classification system is standard for national forest lands in northern Idaho. The various vegetative types designated by P.I. numbers are listed in Appendix B, and descriptions can be used on other land ownerships to designate P.I. type. A plastic guide for estimating degree of stocking for P.I. determinations is available from the U.S. Forest Service (see Appendix B) as are training handbooks (Moessner 1960).

P.I. maps only break vegetation into categories and field sampling is necessary to determine what percent of each category constitutes cover by definition. Lyon's (1984) data provide a guide until site specific information is available for each area in question.

Elk forage is present in openings and under forest canopies, and quantity is usually not a limiting factor on summer range (Christiansen et al. 1993). However, where summer habitats have limited diversity and/or dense overstory canopies, forage may be increased through vegetation manipulation. However, openings that do not provide hiding or thermal cover and are more than 500 feet from cover only receive about 25% of normal use unless there are no open roads in or adjacent to the opening.

Security areas are used by elk as a retreat for safety when disturbance on their usual range is intensified--such as would occur with road construction, or hunting. Leege's 1984 EHE model calculated adequacy of security areas as measured by the percent of the evaluation area qualifying as security areas (pp. 27, section 4, line 3). This counts the effect of roads first by the amount of roads within or adjacent to the analysis area and then by the adequacy of the security areas, which are also defined by their vicinity to roads (see page 11 in Leege 1984). By this definition, an EHE security area counts the effect of roads twice.

To avoid this double counting, we have eliminated (line 3, section 4, page 27) from the EHE model in these guidelines. EHE estimates "potential habitat effectiveness" in relation to of post-sale activities only. Although it is important that security areas be provided for elk during intensified human disturbance, we feel security areas as they shelter elk from intensified activity are better addressed by recommendation #6 in these guidelines.

The value of a security area depends upon the distance from an open road and the amount of cover thereon. In order to qualify as a security area, there must be at least 250 contiguous acres that are more than ½ mile from open roads (Hillis et al 1991). Always consider roads adjacent to the evaluation area as well as those within when determining size of security areas.

COMPUTING HABITAT EFFECTIVENESS

Delineating Elk Analysis Areas (EAA)

Elk analysis areas (EAA) within the EHE model should be between 3,800 and 5,000 acres in size (Leege 1984). EAA's larger than this can dilute the effects of human disturbance on elk summer habitat while smaller EAA's will measure human disturbance effects disproportionate to their size.

To fit EHE measures, EAA boundaries should be determined with consideration of IDFG big game management units (GMU's) and the following.

Priority 1 - prescription watershed - This identifies 3rd or 4th order watersheds and is the final breakdown in the USFS watershed classification system. The watershed number is attached to the Water Resource Council code and is assigned by the forest. These watersheds are listed in the forest plans.

Priority 2 - timber compartment boundaries - These boundaries usually follow ridgelines and/or drainages. In many instances, they match prescription watershed lines exactly. Their average size is between 5,000 and 6,000 acres. The timber compartments system is used USFS-wide and will make EHE databases and analyses interactive with other resource needs and analysis in the USFS.

Priority 3 - timber subcompartment boundaries - These usually follow ridgelines and/or drainages. The average size and number of timber subcompartments can vary greatly. There may be over 7 subcompartments per timber compartment. Timber subcompartments are also used USFS-wide and will make EHE databases interactive with other resource needs and analysis.

All EAA's have been predesignated at a forest and region-wide scale on the Clearwater and Nez Perce National Forests (Appendix C). Areas of winter range should be excluded from EAA designation and EHE analysis. Small patches of winter range not contiguous with mapped winter ranges may be included in designated EAAs. Areas used by elk during both summer and winter are included within designated EAA's. Changes to designated EAA's may be needed at the project level to fine tune sizes and adjust to management areas. These adjustments should be agreed on by IDFG and USFS biologists and managers.

Within each EAA, information is needed on location of the proposed cutting units and roads, and season and type of road closures planned. Much of the information can be gathered from current aerial photos and records. A biologist should field review the area to identify special habitat components, location of security areas, distribution of hiding and thermal cover areas, and examine the forage base to decide whether additional foraging areas created by logging will be beneficial.

A 1:24,000 scale map of each EAA which outlining timber stands in the EAA (each stand is classified as either forage, hiding cover or thermal cover) and roads with their access prescriptions are needed (Figure 4).

For our example, we use an EAA delineated by the methods outlined above (Figure 4). Because the existing (or pre-sale) condition must be determined first, the vegetation and roads should reflect the existing condition and all developments that are in place prior to the project being evaluated. For example, timber sales that have already been sold but not yet cut or roads not yet constructed within the EAA.

Blank and example computation forms are provided in Appendix D. A computer version of the EHE model is available to speed and simplify computations. The computer version of the model also eliminates the inconsistencies which often occur when reading graphs. For the example, the order of the calculations on each form is indicated by letters which follow in alphabetical sequence. The evaluation area and alternatives being evaluated should be indicated in the appropriate places on forms 1 and 2. The calculations are first made for existing pre-sale conditions (including sales already approved but not cut) and then the same computations are made for post-sale conditions. Space is available on Form 2 to evaluate the pre-sale and three post-sale alternatives; however, Form 1 must be completed for each alternative if there are changes in access between alternatives. All calculations made for the example are recorded on the computation sheets for illustration.

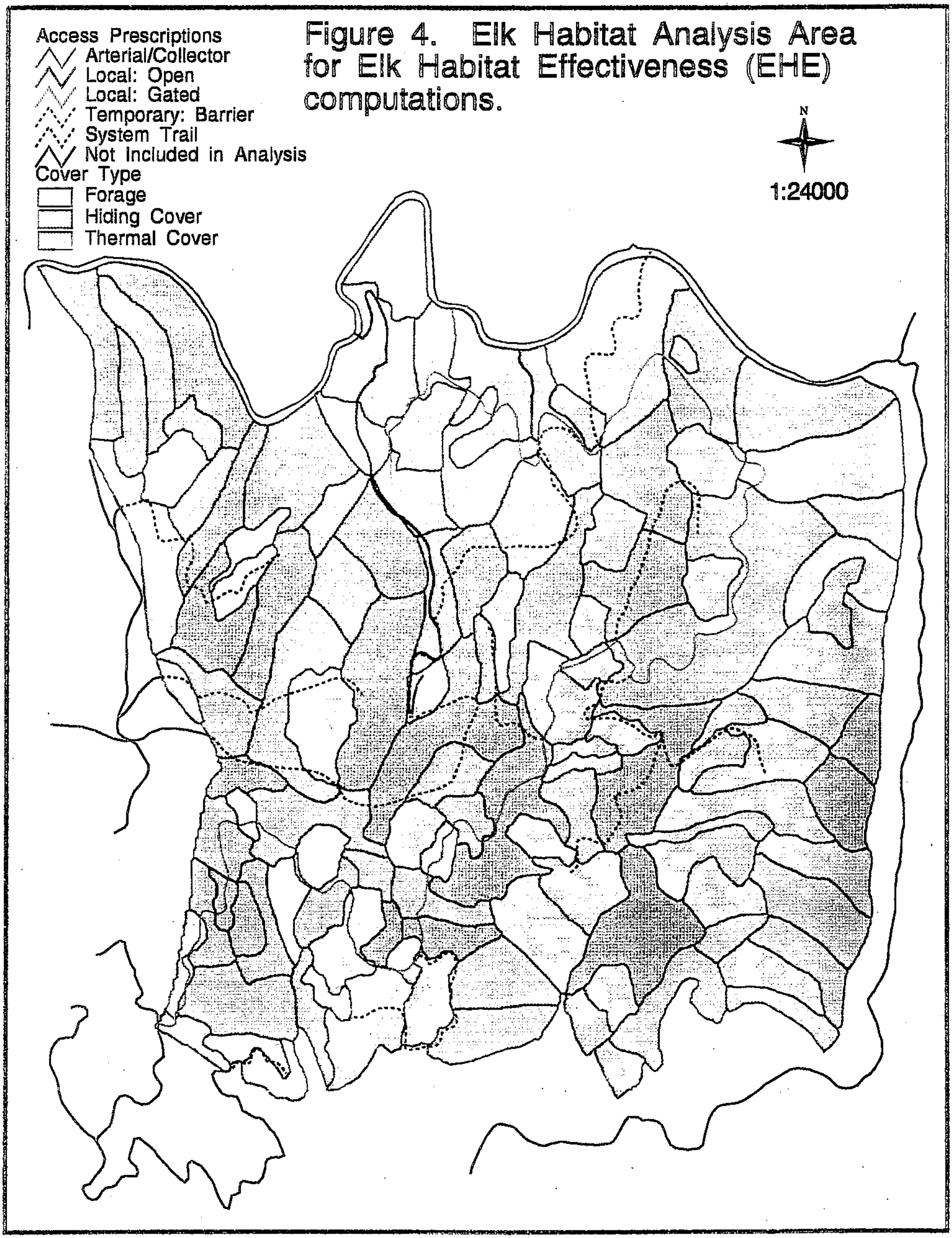

Figure 4. Elk Habitat Analysis Area for Elk Habitat Effectiveness (EHE) computations.

1. Total size of evaluation area

Within this EAA there are no acres of non-use (see winter range under **Evaluation Area)**, so 3,840 is entered for (A). This is converted to square miles by dividing by 640 to give 6 (B).

PLEASE NOTE: THIS EXAMPLE COMBINES PRE-SALE INFORMATION AND POST-SALE INFORMATION TO ARRIVE AT POST SALE NUMBERS

2. Potential elk use as affected by roads

PRE-SALE: Miles of road for each road type, road status and vegetation type (as defined in the footnotes for Table 1) are then determined and entered in one of two columns (C), depending upon whether adjacent vegetation is hiding cover (when a road is going through cover, thermal and hiding count as cover) or open. These mileage values are then multiplied by the figure in Column (D) which is the coefficient for changing all types of roads to a standard road mileage (E). Both (E) columns are then added to get (F) values which are added to arrive at 2.84 for (G). This total standard road mileage is converted to miles of standard road per square mile by dividing by (B) to get 0.47 for (H). This value used with Figure 2 estimates percent of potential use as related to roads (I).

POST-SALE: **The proposed sale adds 2.0 miles of local road (2.0 miles of these are open and 3.0 miles of these are closed with a gate and 2.0 with a barrier and 8.0 are closed completely.** All new proposed roads are in hiding cover. Enter the road miles in column © and do the appropriate calculations to get to column (E). After adding the pre-sale std. miles column (F) with the proposed std. miles column (F) you will get the new std. miles column (G).

3. Potential elk use as related to livestock density

PRE-SALE: The best information available indicates that 40 head of cows with calves occupy about 1.5 square miles within the evaluation area for 50 percent of the period that elk would normally use that area. These values are entered for (K), (J), and (N). Cattle equivalents per
square mile (L) is computed by dividing (K) by (J). Then use (L) with Figure 3 to get (M) which is an estimate of potential elk use for the period when elk and cattle both use the area.

The weighted average (P) then is derived by multiplying potential elk use for each period by its percentage of the total period--and then adding these together for a final value. The formula for (P) shows a divisor of 100 which is necessary to move the decimal to the right place. (P) is then converted using the given formula to 93 percent (Q) for the entire evaluation.

POST-SALE: Both post-sale alternatives keep the same stocking level for cattle so the pre-sale computations would remain the same for post-sale.

4. Potential elk use as related to other factors (refer to Table 2)

PRE-SALE: In our example, P.I. maps in conjunction with Appendix B indicate that about 40 percent of the evaluation area qualifies as hiding cover and 15 percent as thermal cover. Cover is well distributed among the quadrants so deductions for inadequate cover are made.

Rarely will habitat facts fit into one of the categories exactly as listed in Table 2. However, the percent reduction values listed can be used as a guide to assist in assigning an appropriate value.

These "other" factors" add up to 0 percent that is reduced from potential elk use (R), leaving 100 percent of potential use (S).

POST-SALE: In this proposed alternative, not enough timber would be cut to cause hiding or thermal cover inadequacies. The new openings would not be too large for elk use and no additional points would be deducted for having areas too far from cover. An additional 2 miles of road through hiding cover would be contractory. These local roads would be barriered. This would change the potential elk related from 0.77 to 0.74. However 2 percent would be deducted from the size distribution of forage area.

5. Existing and long-term potential elk use.

In this section all impacts on potential elk use are summarized and the remaining potential elk use computed for all alternatives. In the example, all presale factors reduced potential elk use to 71 percent

(T). Under the "Post use" alternative, potential elk use was changed to 67 percent, primarily because of increased roading. Note: Implementing road closures and changing access have the potential to increase the EHE.

COMPUTING ELK VULNERABILITY

A model helps guide IDFG and USFS management of EV. The model is based on research in northern and north-central Idaho (Unsworth et al. 1993). The EV model assumes that elk are not hunted during the rut, that the season length is close to 25 days long, and there are no major antler-point restrictions.

Evaluation Areas

IDFG game management units (GMU's) is the scale the current EV model is applied. These GMU's vary from 1,555 mi^2 to 262 mi^2 in size. The GMU level evaluation provides elk harvest information collected by IDFG telephone surveys of hunters and elk population sizes and elk population composition as estimated by aerial surveys. The GMU scale is suggested as the common scale which the USFS and IDFG base EV management. Estimates of EV at smaller scales such as watersheds (20,000-40,000 acres) and project areas (3,000-5,000 acres) are also important for evaluating, managing, and distributing EV management within and across a GMU landscape. IDFG and USFS biologists need to cooperatively devise EV management at these scales, based on the EV trends and objectives for each GMU. We suggest USFS and IDFG biologists consider the different characteristics and existing conditions of an entire GMU using a GIS-based display and measure of roads and access. These watershed and project level scales of interpretation are important as each project analysis and implementation may effect the overall trend of EV at the GMU scale. Project and watershed-specific EV interpretation is most important in determining whether access management can be cost effective and provide the highest benefit to EV management.

Evaluating and computing EV:

1) Obtain hunter density estimates for each GMU from annual IDFG Big Game Harvest Telephone Surveys. The estimated number of hunter-days for a GMU can be divided by the size (mi^2) of the GMU to obtain hunter density (hunter-days/mi^2).

2) Estimate current open and closed road densities (mi/mi^2) from USFS databases for GMUs on USFS lands. Definitions of roads are included in the Roads section of this document.

3) Compute an initial estimate of bull elk mortality (m), where:

$$m = \frac{e^{u}}{1+e^{u}}$$

where e is the natural antilog (2.71828) and:

$u = -2.036 + (0.635 \times \text{mi open roads/mi}^2) + (0.067\ \text{hunter-days/mi}^2\text{/season})$

4) Add an average of 10% mortality to the predicted rate to account for natural causes of mortality (Unsworth et al. 1993) and convert the predicted estimate of total elk mortality to survival (s; where s = 1-m). Then convert survival to an estimate of the ratio of numbers of bulls:100 cows using Figure 5 or Table 3 with the appropriate cow survival rate. For example, a survival rate of 50% equals bull:cow ratios of 21, 31, 40, 51, and 59 at 90%, 85%, 80%, 75%, and 70% cow survival, respectively.

5) Figure 6 shows the predicted relationship among EV, open road density and hunter density. Predicted bull:cow ratios shown here, as an example, assume 90% survival of cows. Variations in the balance of open road densities and hunter densities result in varying probabilities of bull elk vulnerability. Thus, target EV values (bull:cow ratios) can be managed for by varying the balance of open roads and hunter densities.

Example of elk vulnerability computations

Mean hunter density (hunter-days/mi^2/season) for GMU 12 is calculated using 1990 through 1994 annual Big Game Random Hunter Telephone Surveys data. Hunter density averaged 8.1 $\pm$ 01 SD hunter-days/mi^2/season over this period (IDFG files). The 5-year average for hunter densities and elk harvest are used to reduce the effects of years when hunting seasons showed unusual hunter densities or elk harvest.

Open road density is calculated from USFS road databases. The average road density during 1990 through 1994 was 0.65 mi open road/mi^2 (USFS files).

Table 3. Bull:cow ratios (bull:100 cows) from survival rates. Assumes recruitment is sufficient to balance adult mortality. At lower or higher recruitment, predicted bull:cow ratios would be lower or higher, respectively, than shown here.

Bull Survival Rate	Survival Rate of Cows 60	63	65	68	70	73	75	78	80	83	85	88	90	93
20	50	47	44	41	38	34	31	28	25	22	19	16	13	9
23	52	48	45	42	39	35	32	29	26	23	19	16	13	10
25	53	50	47	43	40	37	33	30	27	23	20	17	13	10
28	55	52	48	45	41	38	34	31	28	24	21	17	14	10
30	57	54	50	46	43	39	36	32	29	25	21	18	14	11
33	59	56	52	48	44	41	37	33	30	26	22	19	15	11
35	62	58	54	50	46	42	38	35	31	27	23	19	15	12
38	64	60	56	52	48	44	40	36	32	28	24	20	16	12
40	67	63	58	54	50	46	42	38	33	29	25	21	17	13
43	70	65	61	57	52	48	43	39	35	30	26	22	17	13
45	73	68	64	59	55	50	45	41	36	32	27	23	18	14
48	76	71	67	62	57	52	48	43	38	33	29	24	19	14
50	80	75	70	65	60	55	50	45	40	35	30	25	20	15
53	84	79	74	68	63	58	53	47	42	37	32	26	21	16
55	89	83	78	72	67	61	56	50	44	39	33	28	22	17
58	94	88	82	76	71	65	59	53	47	41	35	29	24	18
60	100	94	88	81	75	69	63	56	50	44	38	31	25	19
63	107	100	93	87	80	73	67	60	53	47	40	33	27	20
65	114	107	100	93	86	79	71	64	57	50	43	36	29	21
68	123	115	108	100	92	85	77	69	62	54	48	38	31	23
70	133	125	117	108	100	92	83	75	67	58	50	42	33	25
73	145	138	127	118	109	100	91	82	73	64	55	45	36	27
75	160	150	140	130	120	110	100	90	80	70	60	50	40	30
78	178	167	156	144	133	122	111	100	89	78	67	56	44	33
80	200	187	175	162	150	137	125	112	100	88	75	63	50	38
83	229	214	200	186	171	157	143	129	114	100	86	71	57	43
85	267	250	233	217	200	183	167	150	133	117	100	83	67	50
88	320	300	280	260	240	220	200	180	160	140	120	100	80	60

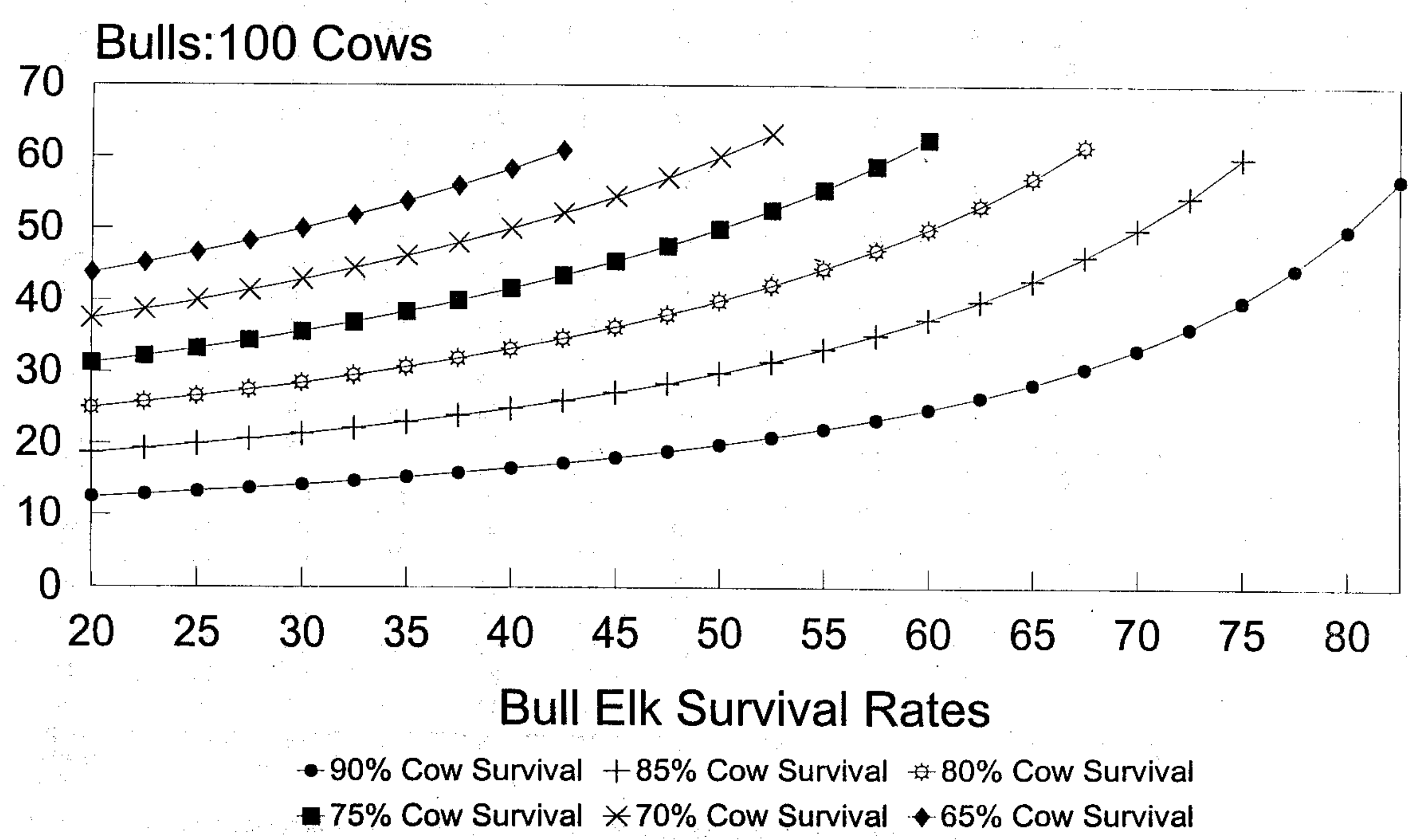

Figure 5. Bull:cow ratios (bull:100 cows) at varying cow survival rates. Ratios assume that recruitment is sufficient to balance mortality of adults (i.e., stable population). At lower recruitment, bull:cow ratios would be lower than shown here. At higher recruitment, bull:cow ratios would be higher than shown here.

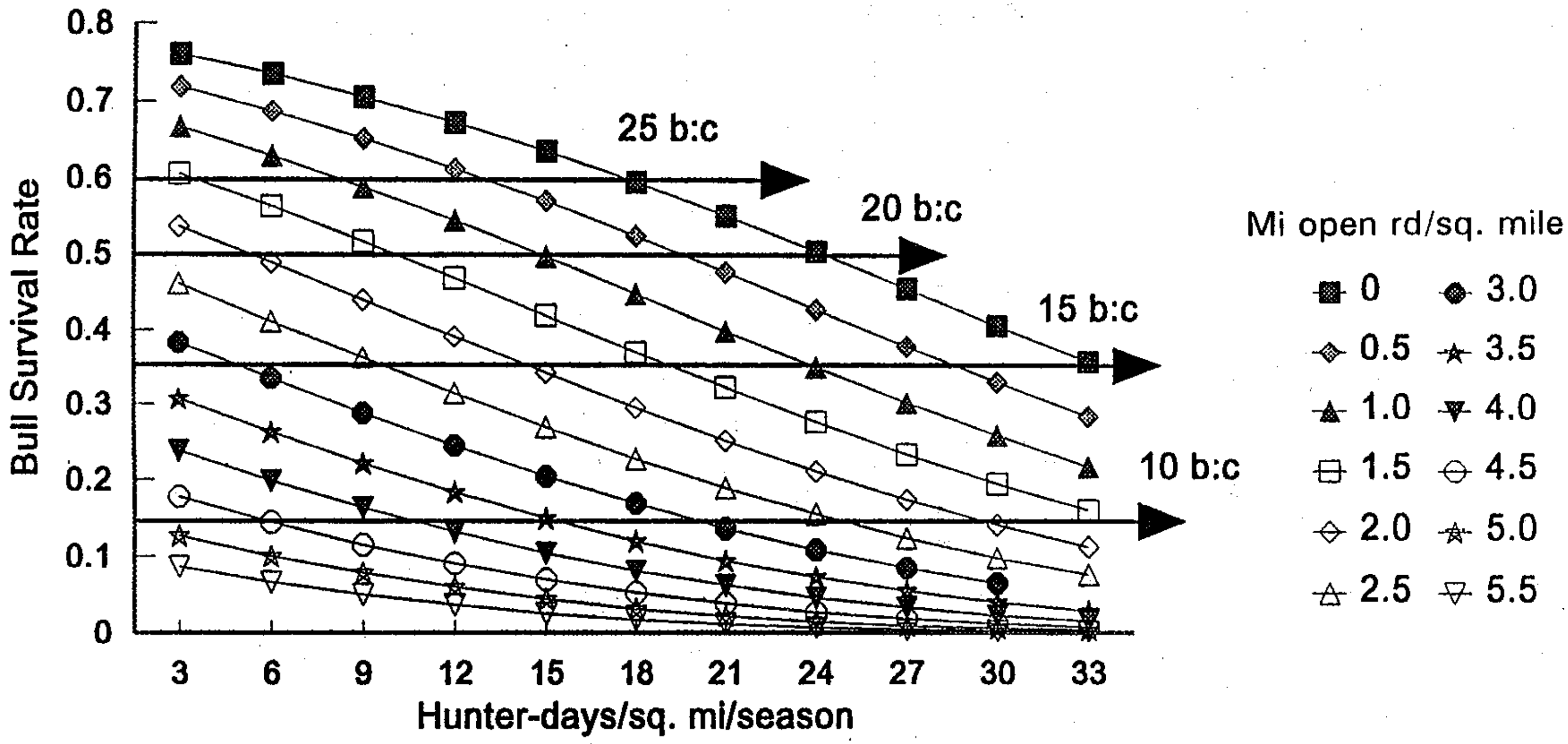

Figure 6. Elk vulnerability model relating bull elk survival and bulls:100 cows to hunter days/mi²/season and miles of open road/mi².

A predicted mortality rate (m) is computed from step 3 above as 0.339, then 0.10 is added to account for an average 10% annual mortality from natural causes. This gives a mortality rate of 0.439. This is converted to a survival rate of 0.561 (1.0 - 0.439 = 0.561).

Using Figure 5, the predicted bull:cow ratio in GMU 12 is estimated by first expressing the average harvest of female elk in GMU 12 from 1990 through 1994 (84.7 ± 22.86 SD) as a percent of the estimated cow population during this period (2559 + 143.6 SD): (84.7/2559 = 3.3%) (IDFG files). This is converted to an average survival rate of cows, assuming an average natural mortality rate of about 10% (1.0-0.10 = 0.9; 0.9-0.033 = 0.867). Precise bull:cow ratios relative to cow survival rates are found in Table 3.

At bull and cow elk survival rates of 56% and 87%, respectively, our predicted bull:cow ratio is about 29 Table 3. Because this vulnerability model predicts an average of 6.7 bulls:100 cows higher than population surveys estimate in north central Idaho GMU's (Gratson, et al. unpub. data), we subtract 6.7 bulls from the y-axis in Figure 5 to arrive at a final predicted bull:cow ratio of 22.3. This approximates the 1990-94 average bull:cow of 19.3:100 ratio estimated for GMU 12 by IDFG aerial surveys. This was a period when recruitment rates were lower than that needed to replace losses of adults. So it is not surprising that the predicted ratio is higher than the actual estimated ratio.

Figure 6 shows the balances in open road density and hunter density that are needed to move toward elk an population objective for a GMU assuming no major changes in general season timing and length.

Because the range of EV objectives for each GMU are based on existing open road densities and hunter densities; each EV "picture" is unique to each GMU.

In the example, GMU 12 has predicted survival rates for bulls and cows of 0.56 and 0.87, respectively. To sustain a bull survival rate of 0.6 would require the USFS to manage access within a range of 0.0 to 1.5 miles/mi^2 of open roads across the GMU while IDFG manages hunter density within a range of 3 - 18 hunter days/mi^2/season. The range and different combinations of these road and hunter densities are the alternatives that can reach EV objectives. An example of EV calculations and differences for a proposed project in GMU 12 are shown in Table 4. Note that bull:cow ratios predicted using the EV model range from 15 for management Option 1 to 25 for Option 4.

Table 4. EV calculations for 4 proposed project options.

	Hunting Mortality Rate	Total Mortality Rate	Total Annual Survival Rate	# Bulls :100 cows	Input Hunter Density (hunter-days-mi²)	Input Hunter Density (hunter-days mi²/season)	u	e^-u
OPTION 1								
Face	0.439	0.539	0.461	11:100	2.78	0.377	-0.24544	0.782359
Canyon/Dead	0.333	0.433	0.567	17:100	2.07	0.377	-.069629	0.498431
Pete King	0.557	0.657	0.343	8:100	3.53	0.377	0.230809	1.259619
Fish/Hung	0.197	0.297	0.703	26:100	0.94	0.486	-1.40654	0.24499
Analysis Area	0.382	0.482	0.519	15:100	2.33			
OPTION 2								
Face	0.209	0.309	0.691	24:100	1.07	0.377	-1.33129	0.264136
Canyon/Dead	0.298	0.398	0.602	18:100	1.82	0.377	-0.85504	0.425266
Pete King	0.220	0.320	0.680	24:100	1.17	0.377	-1.26779	0.281453
Fish/King	0.171	0.271	0.729	29:100	0.67	0.486	-1.57799	0.20639
Analysis Area	0.225	0.325	0.676	24:100	1.18			
OPTION 3								
Face	0.210	0.310	0.690	24:100	1.08	0.377	-1.32494	0.265819
Canyon/Dead	0.439	0.539	0.461	11:100	2.78	0.377	-0.24544	0.782359
Pete King	0.214	0.314	0.686	24:100	1.12	0.377	-1.29954	0.272657
Fish/Hung	0.176	0.276	0.724	29:100	0.72	0.486	-1.54624	0.213048
Analysis Area	0.260	0.360	0.640	22:100	1.43			
OPTION 4								
Face	0.235	0.335	0.665	22:100	1.31	0.377	-1.17889	0.30762
Canyon/Dead	0.194	0.294	0.706	26:100	0.92	0.377	-1.42654	-0.240138
Pete King	0.206	0.306	0.694	24:100	1.04	0.377	-1.35034	0.259152
Fish/Hung	0.194	0.294	0.706	26:100	0.91	0.486	-1.42559	0.240367
Analysis Area	0.207	0.307	0.693	25:100	1.05			

TRAINING TO MEASURE AND EVALUATE EHE AND EV

New and transferring IDFG and USFS wildlife personnel responsible for application and interpretation of EHE and EV measures will require training. These may include USFS district and forest wildlife biologists, resource staff officers, district rangers, IDFG regional wildlife and habitat biologists and managers. Training in use and interpretation of the models is important to maintaining a standard measure of EHE and EV for adaptive management.

Training should be implemented by personnel familiar with either elk model. Training sessions should cover: 1) Road definitions, their link to the RMAS database, and the limits to manipulating their associated coefficients, 2) Review of the EHE rules assumptions, and recommendations, 3) Calculation of potential elk use as related to the long-term effects of development and how that effects existing condition of the EAA's prior to 3 years post activity, 4) The difference between EV and EHE management, 5) Use of the computer-based EHE model to manipulate and evaluate alternatives, 6) The methodology for measuring forage and cover, 7) The basis for delineation of EAA unit boundaries, 8) How motorized vehicle access affects EV and EHE, 9) How security cover is factored into EHE, 10) A step-by-step process measuring EV using the PG-based model, 11) The origins and derivations of the hunter density, road density, and aspect variables, 12) The basis for the scale of EV analysis, 13) The difference between project level and planning level EV management and monitoring. 14) Interpretation and consideration of factors influencing EV variables at the project and regulation levels, and 15) The interagency emphasis in measuring and managing EHE and EV.

RECOMMENDATIONS FROM THE USFS/IDFG ELK EFFECTIVENESS TECHNICAL TEAM

Implementing the following recommendations will increase effective management of EHE and EV.

1) IDFG and the Clearwater and Nez Perce national forests should implement a management effort to measure the differences and effectiveness of road closure types. A cooperative monitoring effort of gated and barriered roads can assist validation of EHE coefficients relative to administrative and illegal traffic of closed roads and trails.

2) Penalties for road closure violations need to be increased. The cooperators should jointly submit a letter to judges and magistrates in their jurisdictions to increase penalties for closure violations. A more concerted effort to apprehend and publicize road closure violators is needed.

3) The EHE and EV models should be built for use in GIS and PC environments.

4) Planning and adaptive management needs to consider how EHE is managed over the long term and on a forest-wide scale. The delineated EAA's in these guidelines should be used to balance planning objectives with existing conditions, measure management trends, and devise adaptive management experiments.

5) Implement elk winter range management by delineating winter ranges based on subunit stratification as determined by IDFG elk sightability flights. Using a GIS format, delineate subunits and elk distribution using global positioning system (GPS) data.

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APPENDICES

APPENDIX A

FOOD HABITS (PERCENT OF DIET) OF ROCKY MOUNTAIN ELK DURING SPRING, SUMMER, AND FALL MONTHS IN NORTHERN IDAHO[1]

	Spring	Summer	Fall
Grasses and sedges	37	17	17
Forbs	20	35	30
Shrubs	43	48	53

Important species in spring: bluebunch wheatgrass, clover, elk sedge, goldthread, Idaho fescue, mountain brome, myrtle boxwood, oniongrass, orchardgrass, Oregon grape, redstem ceanothus, shiny leaf ceanothus, strawberry, violet, willow.

Important species in summer: beardtongue, boykinia, elderberry, false hellbore, fireweed, fool's huckleberry, goldthread, huckleberry, miner's lettuce, mountain ash, mountain brome, myrtle boxwood, oniongrass, Pacific yew, redstem ceanothus, serviceberry, shiny leaf ceanothus, tall bluebell, wakerobin.

Important species in fall: beardtongue, elderberry, fireweed, goldthread, huckleberry, mountain ash, myrtle boxwood, Pacific yew, redstem ceanothus, shiny leaf ceanothus, willow.

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[1]Percentages are averages of data from Young and Robinette (1939), Hash (1973), Irwin (1978), Herman (1978), and Leege (unpublished data). Important species were also taken from these references.

APPENDIX B

DESCRIPTIONS OF PHOTO INTERPRETATION (P.I.) TYPES USED WHEN CLASSIFYING VEGETATION FROM AERIAL PHOTOS[1]

I. STAND HEIGHT GREATER THAN 40 FEET

A. Coarse texture - usually indicates mature or overmature sawtimber
   11 - Well stocked
   12 - Medium stocked
   13 - Poorly stocked

B. Fine texture - small sawtimber or pole stands. These are not easily separated as to maturity, and may be either mature or immature, depending on site, etc.
   14 - Well stocked or overstocked
   15 - Medium stocked
   16 - Poorly stocked

C. Two-storied - At least 15-20 feet height difference between overstory and understory.

   Unmanageable Two-Story Stands
   Overstory well or medium stocked - classify as under A or B above.

   Manageable or Potentially Manageable Two-Story Stands
   Overstory generally poorly stocked but no more than medium stocked.
   17- Understory well and medium stocked
   18- Understory poorly stocked. Understory with at least 100 trees per acre.

D. Cutover - areas with obvious evidence of man's recent cutting activities, such as cutting unit boundaries, characteristic roading systems, etc.

   Cutover - Coarse Texture
   19 - Well or medium stocked
   20 - Poorly stocked

Cutover - Fine Texture
21 - Well or medium stocked
22 - Poorly stocked

Cutover - Two-Storied
23 - Residual overstory with a well or medium stocked understory.
24 - Residual overstory with poorly stocked understory.

II. STAND HEIGHT LESS THAN 40 FEET

A. Coarse texture
25 - Well and medium stocked
26 - Poorly stocked

B. Fine texture
27 - Well stocked immature stands less than pole size, usually, but may also be stagnated.
28 - Medium stocked
29 - Poorly stocked
30 - Apparently nonstocked (refers to conifer trees)-due to natural conditions such as fire, but not due to logging.

C. Cutover
31 - Well and medium stocked residual after cutting
32 - Poorly stocked residual
33 - Apparently nonstocked after cutting

III. OTHER

91 - Noncommercial forest
92 - Water
93 - Nonforest

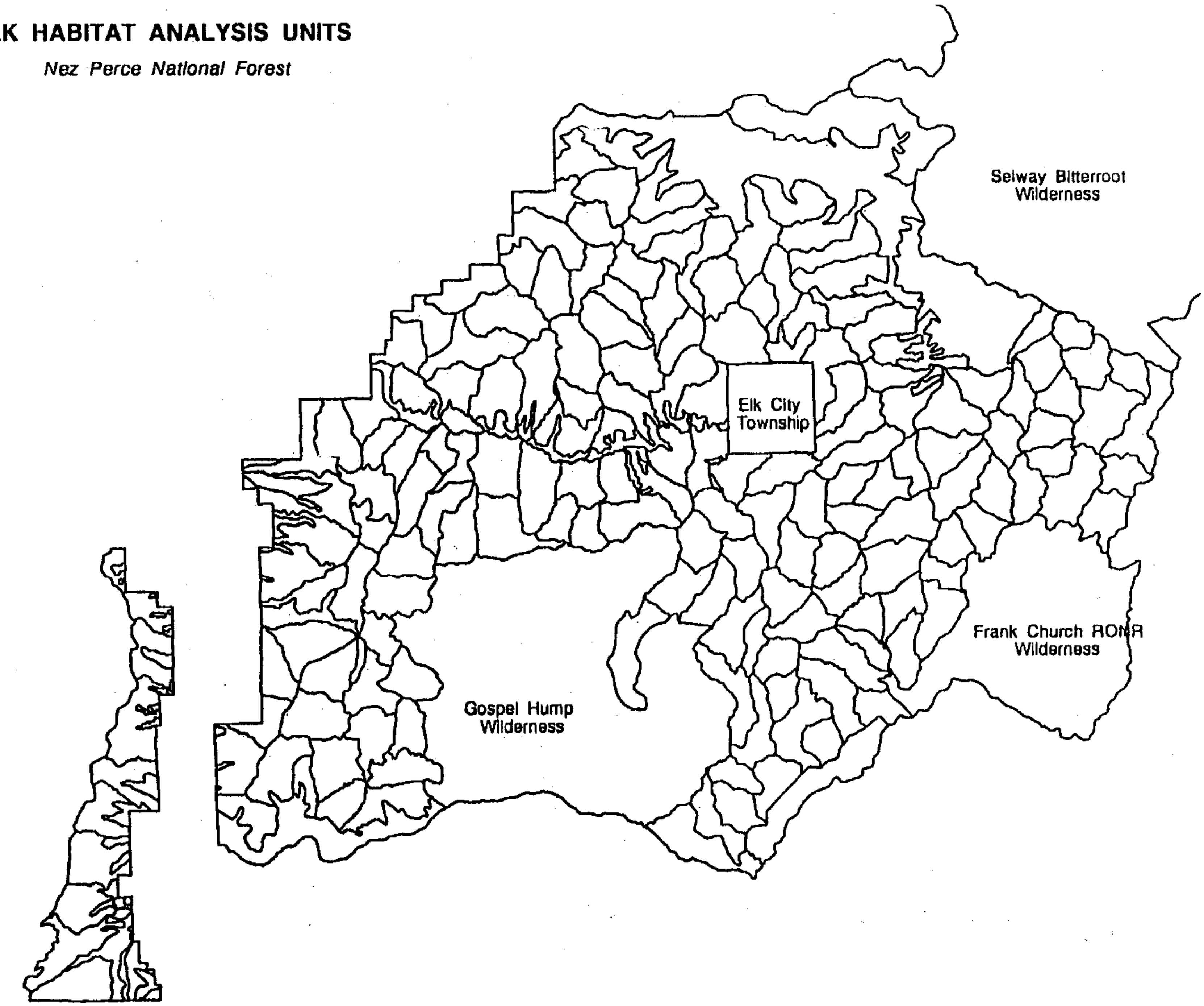
[1]A plastic guide (timber survey aid no. 5) for estimating degree of stocking for P.I. determinations is available from: Regional Forester, U.S. Forest Service, P.O. Box 3623, Portland, OR 97208. Training handbooks (Moessner 1960) can also be obtained.

APPENDIX C

ELK ANALYSIS AREA MAPS FOR THE NEZ PERCE AND CLEARWATER NATIONAL FORESTS

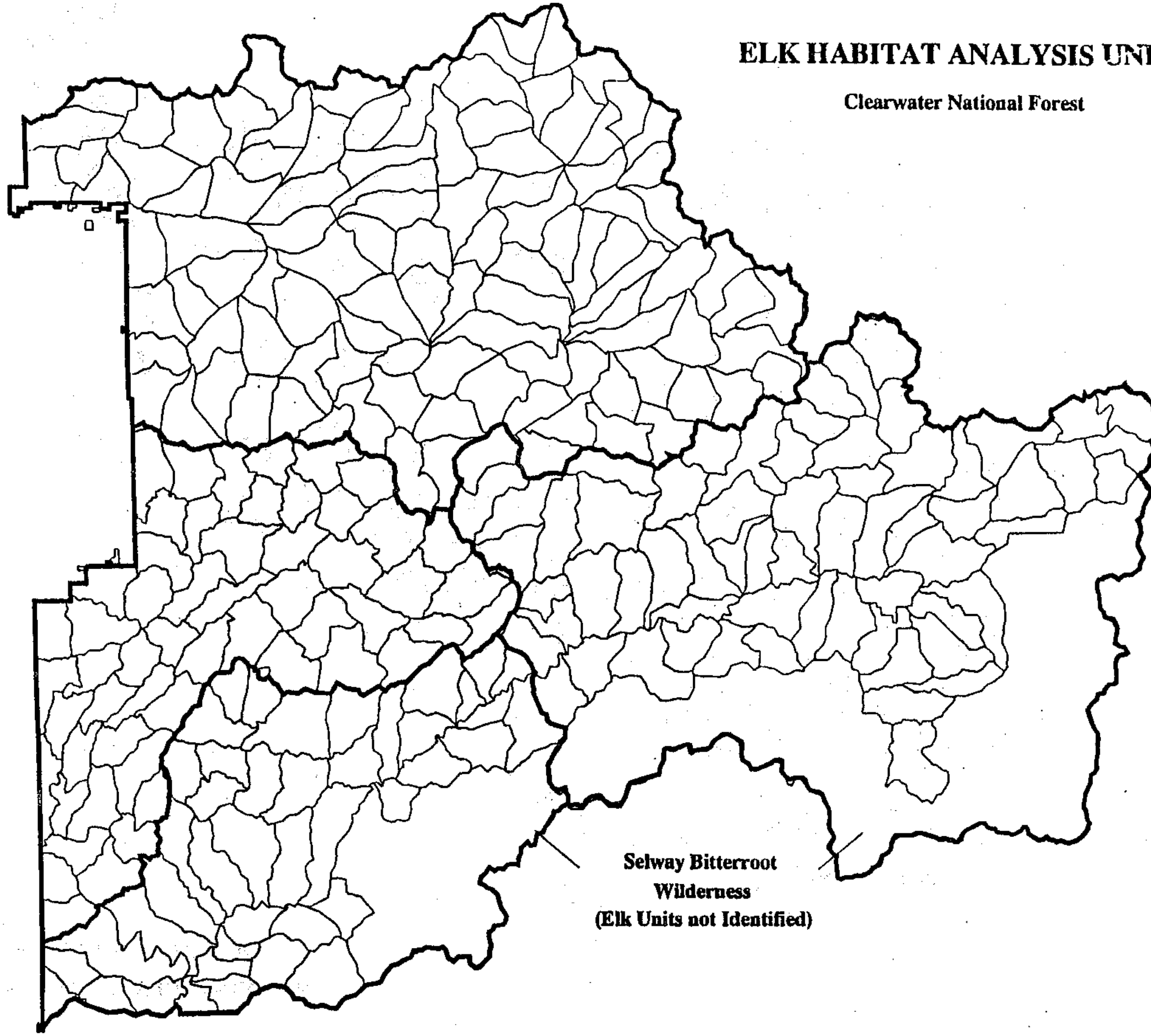
ELK HABITAT ANALYSIS UNITS

Nez Perce National Forest



ELK HABITAT ANALYSIS UNITS

Clearwater National Forest



APPENDIX D

COMPUTATION FORMS

Calculated by: ______________________
Date: ______________________

AREA: Example
ALTERNATIVE: Post-Sale

ESTIMATING QUALITY OF ELK SUMMER HABITAT IN NORTHERN IDAHO

1. Total size of evaluation area in usable acres[1] 3840 (A); and square miles (A÷640) 6 (B)
2. Potential elk use as affected by roads.[2]

		Hiding Cover			Open		
Road Type	Road Status	Miles (C)	Coeff. (D)	Std. Miles (C x D) (E)	Miles (C)	Coef. (D)	Std. Miles (CxD) (E)
Arterial/Collector	Open	0	.80	0.80	0.5	1.20	0.6
	Closed w/ gates		.24			.36	
	Closed w/ barrier		.08			.12	
	Closed completely		.00			.00	
Local	Open	2.0	.50	1.0		.90	
	Closed w/ gates	3	.15	0.45	1.0	.27	0.09
	Closed w/ barrier	2.0	.05	0.10		.09	
	Closed completely	8.0	.00	0		.00	
Temporary Road & System Trail	Open	1.0	.03	0.03	1.0	.07	0.07
	Closed w/ gates		.01			.02	
	Closed w/ barrier		.01			.01	
	Closed completely		.00			.00	

Subtotal Std. Miles 2.38 (F) 0.76 (F)
Total Std. Miles (F+F) 3.14 (G)

Miles of standard road per square mile (G÷B) 0.52 (H)

Percent of potential elk use after road effects [use (H) and Fig. 2] 74% (I)

[1] All acres usable *except* talus, water surface, and other areas elk would not use because of *natural* features—may also include winter range.

[2] Refer to Table 2 for coefficient information and definitions of road and vegetation types.

alculated by: ______________________
Date: ______________________

AREA: Example
ALTERNATIVE: Pre- Sale

ESTIMATING QUALITY OF ELK SUMMER HABITAT IN NORTHERN IDAHO
(continued)

	Pre-Sale	Post Sale	Post-Sale Alternatives	
. Potential elk use as related to livestock density	Pre-Sale	Post Sale	______	______
Square Miles within evaluation area used by Livestock	(J) 1.5	1.5	______	______
Total cattle equivalents using area	(K) 40	______	______	______
Cattle equivalents per sq. mi. (K÷J)	(L) 26.66	______	______	______
Percent of potential elk use [use (L) and Fig.3]	(M) 47 %	____%	____%	____%
Percent of elk use period used by livestock	(N) 50 %	____%	____%	____%
Weighted percent of potential elk use on livestock portion $\frac{(MxN) + 100\ (100-N)}{100}$	(P) 73 %	____%	____%	____%
Percent of potential use on entire evaluation area $\frac{(PxJ) + 100\ (B-J)}{B}$	(Q) 93 %	____%	____%	____%

4. Potential elk use as related to other factors. (Refer to Table 3)

Size and distribution of hiding and thermal cover	0 %	0 %	____%	____%
Size and distribution of forage areas	0 %	____%	____%	____%
Adequacy of security areas	0 %	0 %	____%	____%
Total decrease from these factors	0 %	2 %	____%	____%
Potential elk use remaining (100-R).	100 %	98 %	____%	____%

	Pre-Sale	Post Sale Alternatives		
5. EXISTING AND LOG-TERM POTENTIAL ELK USE	Pre-Sale	______	______	______
Potential elk use of home range	100 %	100%	100%	100%
Potential use as related to roads	(I) 77 %	74 %	____%	____%
Potential use as related to livestock	(Q) 93 %	93 %	____%	____%
Potential use as related to other factors	(S) 00 %	98 %	____%	____%
REMAINING POTENTIAL ELK USE	(T) 71 %	67 %	____%	____%

(100%)x (I)/100x(Q)/100x(S)/100 =

FORM 1

Calculated by: ____________________ AREA: ____________________

Date: ____________________ ALTERNATIVE: ____________________

ESTIMATING QUALITY OF ELK SUMMER HABITAT IN NORTHERN IDAHO

1. Total size of evaluation area in usable acres[1] ____ (A); and square miles (A÷640) ____(B)
2. Potential elk use as affected by roads.[2]

Vegetation Adjacent to Roads

Road Type	Road Status	Hiding Cover Miles (C)	Hiding Cover Coeff. (D)	Hiding Cover Std. Miles (C x D) (E)	Open Miles (C)	Open Coef. (D)	Open Std. Miles (CxD) (E)
Arterial/Collector	Open	______	.80	______	______	1.20	______
	Closed w/ gates	______	.24	______	______	.36	______
	Closed w/ barrier	______	.08	______	______	.12	______
	Closed completely	______	.00	______	______	.00	______
Local	Open	______	.50	______	______	.90	______
	Closed w/ gates	______	.15	______	______	.27	______
	Closed w/ barrier	______	.05	______	______	.09	______
	Closed completely	______	.00	______	______	.00	______
Temporary Road & System Trail	Open	______	.03	______	______	.07	______
	Closed w/ gates	______	.01	______	______	.02	______
	Closed w/ barrier	______	.01	______	______	.01	______
	Closed completely	______	.00	______	______	.00	______

Subtotal Std. Miles ________ (F) ______(F)

Total Std. Miles (F+F) ________ (G)

Miles of standard road per square mile (G÷B) ______(H)

Percent of potential elk use after road effects [use (H) and Fig. 2] ______(I)

[1] All acres usable *except* talus, water surface, and other areas elk would not use because of *natural* features--may also include winter range.

[2] Refer to Table 2 for coefficient information and definitions of road and vegetation types.

Calculated by: ______________________ AREA: ______________

Date: ______________________ ALTERNATIVE: ______________

ESTIMATING QUALITY OF ELK SUMMER HABITAT IN NORTHERN IDAHO
(continued)

3. Potential elk use as related to livestock density	Pre-Sale	Post-Sale Alternatives: Post Sale	____	____
Square Miles within evaluation area used by Livestock	(J)____	____	____	____
Total cattle equivalents using area	(K)____	____	____	____
Cattle equivalents per sq. mi. (K÷J)	(L)____	____	____	____
Percent of potential elk use [use (L) and Fig.3]	(M)____%	____%	____%	____%
Percent of elk use period used by livestock	(N)____%	____%	____%	____%
Weighted percent of potential elk use on livestock portion $\frac{(MxN) + 100 (100-N)}{100}$	(P)____%	____%	____%	____%
Percent of potential use on entire evaluation area $\frac{(PxJ) + 100 (B-J)}{B}$	(Q)____%	____%	____%	____

4. Potential elk use as related to other factors. (Refer to Table 3)				
Size and distribution of hiding and thermal cover	____%	____%	____%	____
Size and distribution of forage areas	____%	____%	____%	____%
Adequacy of security areas	____%	____%	____%	____
Total decrease from these factors	____%	____%	____%	____
Potential elk use remaining (100-R)	____%	____%	____%	____%

5. EXISTING AND LOG-TERM POTENTIAL ELK USE	Pre-Sale	Post Sale Alternatives: ____	____	____
Potential elk use of home range	____%	____%	____%	____%
Potential use as related to roads	(I)____%	____%	____%	____%
Potential use as related to livestock	(Q)____%	____%	____%	____%
Potential use as related to other factors	(S)____%	____%	____%	____%
REMAINING POTENTIAL ELK USE (100%)x (I)/100x(Q)/100x(S)/100 =	(T)____%	____%	____%	____%

APPENDIX E

A PARTIAL GLOSSARY OF ELK MANAGEMENT TERMS

United States
Department
of Agriculture

Forest Service

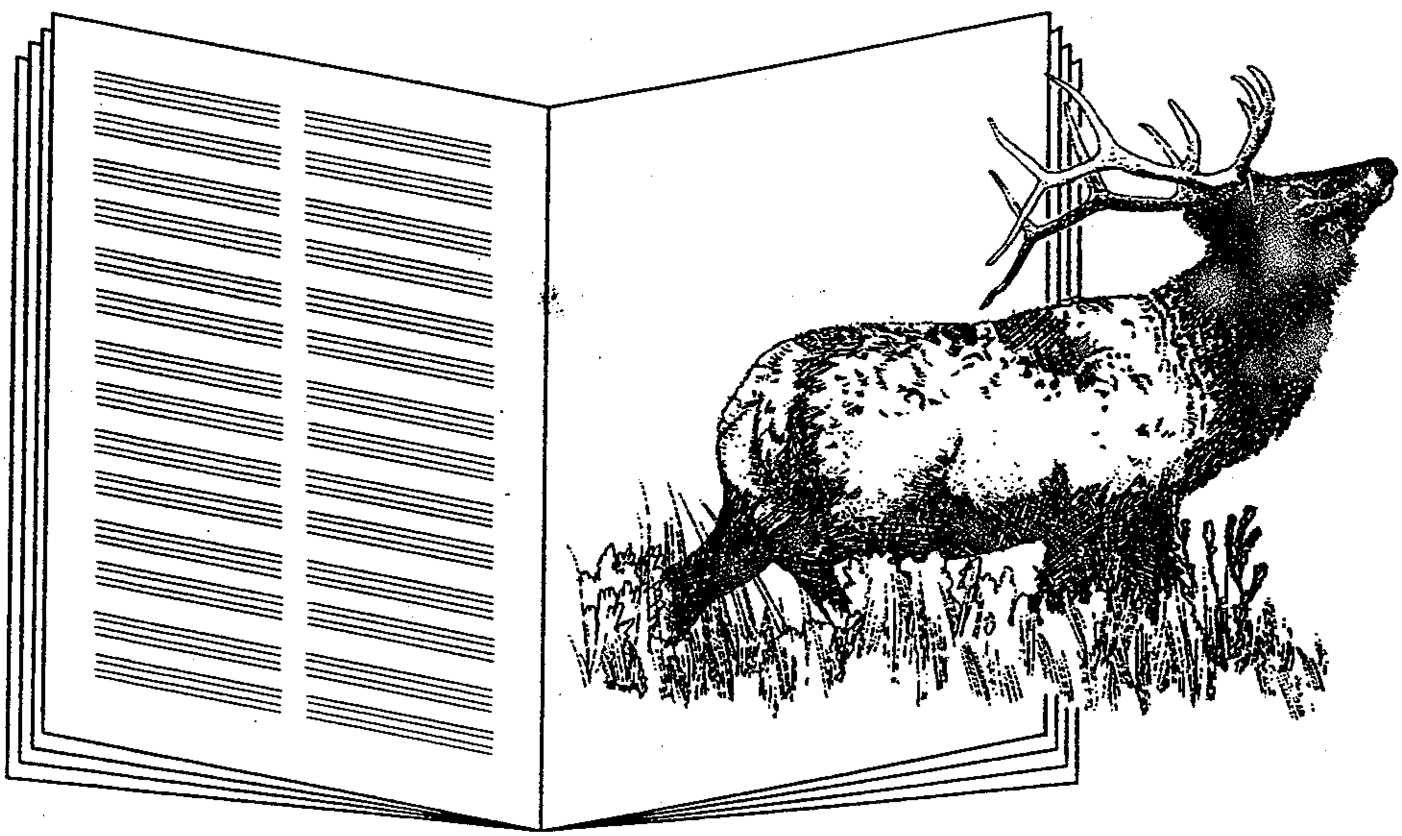
Intermountain
Research Station

General Technical
Report INT-288

June 1992

A Partial Glossary of Elk Management Terms

L. Jack Lyon
Alan G. Christensen



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RESEARCH SUMMARY

Elk habitat management guidelines have been incorporated into forest plans throughout North American elk range. These guidelines were developed from research on the influences of timber sales and roads during the summer months. Use of these guidelines has too often resulted in inappropriate extrapolation of available information to applications on winter range, hunting seasons, and other conditions outside the scope of the original research.

As a result of extrapolation, some commonly used terms have taken on several meanings, unusual analysis procedures have been developed, and some completely new terminology has been created. There have been applications that are confusing to managers and the public alike. It is essential that the terminology of elk habitat management be clarified.

This paper presents the results of an "Elk Management Terminology Workshop" held at the University of Montana's Lubrecht Experimental Forest on April 3 and 4, 1990. Biologists representing State and Federal governments, universities, and private management concerns participated in a facilitated workshop to identify the most commonly misused terms in elk management guidelines and develop consensus definitions.

ACKNOWLEDGMENTS

We are deeply indebted to the many biologists who helped to organize and complete this project. This paper was originally presented at the Western States and Provinces Elk Workshop in Eureka, CA, May 15-17, 1990. It appears in the proceedings of that workshop, but is being revised and reprinted to obtain wider circulation in the Rocky Mountain West.

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A Partial Glossary of Elk Management Terms

L. Jack Lyon
Alan G. Christensen

INTRODUCTION

Over the past decade we have witnessed the development and proliferation of elk habitat management guidelines throughout North American elk range. These guidelines were primarily developed from research on the influences of timber sales and roads on elk behavior and summer/fall habitat use. However, the development of forest plans and environmental evaluations have too often resulted in inappropriate extrapolation of available information to applications on winter range, hunting seasons, and other conditions outside the scope of the original research.

In the course of this extrapolation, some commonly used terms have taken on several meanings, unusual analysis procedures have appeared, and some completely new terminology has been created. Some applications have been confusing to managers and the public alike. The future of elk management depends on clear communication among agency personnel and the public. We believe it is essential that the terminology of elk habitat management be clarified and standardized.

This paper presents the results of an "Elk Management Terminology Workshop" held at the University of Montana's Lubrecht Experimental Forest on April 3 and 4, 1990. Biologists representing State and Federal governments, universities, and private management concerns participated in a facilitated workshop to identify the most commonly misused terms in elk management guidelines and develop consensus definitions.

Neither the workshop nor this paper could be comprehensive. Most common terminology in elk management is easily understood and used correctly. The recommended definitions for some terms that have often been misinterpreted or used in ways that suggest two or more meanings are presented here. Workshop participants identified some terms that have been so misused as to become virtually meaningless. We recognize that everyone will not agree with our assessments. We expect misuse will continue. Maybe the best we can hope for is to take a step toward making it possible for professionals to communicate with each other.

SELECTION OF TERMS

The Elk Management Terminology Workshop emerged from discussions among eight to 10 concerned biologists in Montana and northern Idaho. An initial list of terms to be discussed was generated by this group. This list was circulated to State and Federal biologists and managers actively involved in elk management and the application of elk management guidelines. Participants were asked to indicate the most troublesome terms on the list and write in additional terms if needed. Based on the responses, about 30 respondents were invited to a formal workshop on the terminology of elk management.

We selected 44 commonly used elk management terms for further study. Each term was sent to at least one prospective workshop participant. Some were sent to as many as three participants. Each participant was asked to determine the history and origin of the assigned terms, to note when they were first used in the literature, and to recommend an acceptable definition. Returns from this second mailing were particularly edifying when some participants supplied their own definitions without recourse to the literature.

At the beginning of the workshop, all recommended definitions were distributed to participants. We determined that about a third of the terms are the source of most of the confusion and misuse. Another third have perfectly acceptable definitions and are rarely misused. Troublesome terms were often interconnected so that misuse of one resulted in confusion and misuse of several others. Finally, we discovered that troublesome terms often had a good definition for either structure or function, but not both. If one definition is missing, for instance, function, the term is likely to be misused or misinterpreted, or both.

Participants were split into three workshop groups. All three groups discussed the highly controversial terms. Less difficult terms were handled by only one group. At the conclusion of the workshop, participants recommended development of a new term:

ACCESSIBILITY INDEX: This term will become an essential component of future management for elk security during the hunting season. It is needed to summarize the degree of human access facilitated by such components as roads, trails and their management, terrain and vegetation, season length, and legal restrictions. No specific definition is proposed at this time, but we recommend that research in this area recognize the need for broad applicability.

WORD LIST

BEDDING AREA	HERD HOME RANGE
BULL AGE DIVERSITY	HIDING COVER
CALVING AREAS	HUNTER OPPORTUNITY
CARRYING CAPACITY	KEY COMPONENTS
COVER FORAGE RATIOS	MIGRATION CORRIDOR
CRITICAL HABITAT	NURSERY AREAS
CUMULATIVE EFFECTS	OBJECTIVES
ELK EFFECTIVE COVER	OPEN ROAD EQUIVALENTS
ELK EVALUATION/ ANALYSIS AREAS	OPEN VEGETATION
	OPTIMAL COVER
ELK HABITAT POTENTIAL	POPULATION/HABITAT UNIT
ELK MANAGEMENT UNIT	POTENTIAL ELK USE
ELK USE POTENTIAL	ROAD INFLUENCE
ELK VULNERABILITY	SECURITY
ESCAPE COVER	SECURITY AREA
ESCAPEMENT	SECURITY COVER
FORAGE AREA	SECURITY HABITAT
FORESTED FORAGE	SIGHT DISTANCE
GAME MANAGEMENT UNIT	THERMAL COVER
HABITAT ANALYSIS UNIT	TRANSITIONAL RANGE
HABITAT CAPABILITY	TRANSITORY RANGE
HABITAT EFFECTIVENESS	WINTER RANGE
HABITAT USE POTENTIAL	

GLOSSARY

Terms evaluated in the workshop discussions are presented here in alphabetical order, and interrelated terms are cross referenced. Those terms rarely misused are not discussed. Words in all capital letters are defined elsewhere in the glossary.

BEDDING AREA: A specific site selected by big game animals to lie down and rest. See OBJECTIVES.

BULL AGE DIVERSITY: An attribute of population age structure providing a relative measure of the distribution of bull elk among age classes in a population. See OBJECTIVES.

CALVING AREAS: Any areas between WINTER RANGE and summer range where cows give birth to calves.

Discussion: This may be a specific area where a majority of calving for a herd takes place. It may also be scattered locations throughout the HERD HOME RANGE. See OBJECTIVES.

CARRYING CAPACITY: Maximum rate of animal stocking without damaging vegetation or related resources.

Discussion: This is a well-established biological concept, but it is too imprecise for any useful application in elk management terminology.

Recommendation: Avoid using this term in relation to elk.

COVER FORAGE RATIOS: The percentage of a HABITAT ANALYSIS UNIT in cover condition, and the percentage in forage condition, expressed as a ratio totaling 100.

Discussion: COVER:FORAGE has had general application and can be useful in discussing the diversity of summer elk habitat. Application of the term is usually related to habitat models and habitat analysis, but COVER:FORAGE is not an evaluation of overall habitat quality. It should be recognized that COVER:FORAGE contains no inherent provision of SECURITY.

Recommendation: Use of the term should be limited to applicable situations described in the literature.

CRITICAL HABITAT: A term preempted by the Endangered Species Act of 1973 and considered inappropriate in elk management since then.

Recommendation: Do not use this term when KEY COMPONENT is intended.

CUMULATIVE EFFECTS: The additive impacts when a number of unrelated, or related but discrete, management activities take place in a given area.

Discussion: Multiple impacts on wildlife populations of simultaneous but not necessarily coordinated human activities have been recognized as extremely difficult to measure and express. Commonly included are past, present, and reasonably foreseeable future activities. We will need technologies for considering multiple effects as the implications of hunting season SECURITY become more apparent.

ELK EFFECTIVE COVER: As used in several forest plans, this term appears to be equivalent to HABITAT EFFECTIVENESS, but it includes implications of both habitat productivity and SECURITY.

Discussion: Because of the way it is used, the term appears to provide habitat information that does not, in fact, exist.

Recommendation: This term should only be used on those forests where it appears in the forest plan. Every effort should be made to clarify the usage so as not to include SECURITY or productivity.

ELK EVALUATION/ANALYSIS AREAS: See HABITAT ANALYSIS UNIT.

ELK HABITAT POTENTIAL: Cannot be defined, although it has been used as a synonym for CARRYING CAPACITY, for HABITAT CAPABILITY, and for ELK USE POTENTIAL.

Discussion: This appears to be a term that tries to find some middle ground between elk use and CARRYING CAPACITY. As a result, the term also confuses accepted definitions of HABITAT EFFECTIVENESS. See ELK USE POTENTIAL for further discussion.

Recommendation: Do not use this term.

ELK MANAGEMENT UNIT: An administrative unit established by the Montana Department of Fish, Wildlife and Parks. See HABITAT ANALYSIS UNIT.

Discussion: Other States probably use other terms.

Recommendation: This term should not be used in reference to habitat analysis.

ELK USE POTENTIAL: A scaled representation of maximum possible use by elk.

Discussion: ELK USE POTENTIAL is the standard against which HABITAT EFFECTIVENESS is normally calculated. It is not, however, an acceptable expression of HABITAT CAPABILITY or CARRYING CAPACITY. Other terms cross-referenced to ELK USE POTENTIAL include ELK HABITAT POTENTIAL, POTENTIAL ELK USE, HABITAT USE POTENTIAL, and HABITAT CAPABILITY. All of these terms strive to identify the ability of a habitat to support elk. However, they are almost always used in a context that compares current with predicted elk use in relation to changes in vegetation. The terms based on "use" appear in the literature related to habitat models. They are probably valid synonyms.

Recommendation: These terms should be used only as justified by the existing literature. They should not be considered random synonyms, and under no circumstances should they be considered equivalent to either CARRYING CAPACITY or HABITAT EFFECTIVENESS.

ELK VULNERABILITY: A measure of elk susceptibility to being killed during the hunting season. This is the antonym of SECURITY during the hunting season.

Discussion: This is primarily a functional concept that is the sum of many factors such as SECURITY, HUNTER OPPORTUNITY, hunter behavior, and elk behavior. It has often been defined in ways related to ESCAPEMENT of branch-antlered bulls.

Recommendation: This term represents a complex area in which a great deal of research remains to be done.

ESCAPE COVER: Vegetation dense enough to aid animals in escaping from potential enemies.

Discussion: Although this is one of the oldest terms in game management, workshop participants considered it too imprecise for use in elk management. It appears as a synonym for SECURITY, SECURITY AREA, SECURITY COVER, and HIDING COVER, but fails to convey any satisfactory meaning.

Recommendation: Do not use this term.

ESCAPEMENT: The number, or proportion, of elk surviving the hunting season. Frequently the emphasis is on specific age and sex classes of elk.

Discussion: In common usage there is confusion with ESCAPE COVER and with the act of escaping. Fisheries literature is clear and useful, indicating that this term can be used to describe the number of animals surviving.

FORAGE AREA: In habitat evaluation models, the percentage of a HABITAT ANALYSIS UNIT not considered HIDING COVER or THERMAL COVER.

Discussion: The workshop agreed that this term will be used correctly in most instances. However, some elk habitat models define FORAGE AREA as openings, which confuses the status of forage found within timber stands. See FORESTED FORAGE.

FORESTED FORAGE: Sometimes used in habitat evaluation models to describe FORAGE AREA within forest stands that are neither HIDING COVER nor THERMAL COVER.

Discussion: Although intended to be a solution, FORESTED FORAGE has become an additional problem. One workshop group noted that because valuable forage is often found in defined cover areas, the term might be interpreted to include all of COVER:FORAGE.

Recommendation: If used at all, this term should be carefully and specifically defined by the user.

GAME MANAGEMENT UNIT: An administrative unit established by the Idaho Fish and Game Department. See HABITAT ANALYSIS UNIT.

Discussion: Other States probably use other terms.

Recommendation: This term should not be used in reference to habitat analysis.

HABITAT ANALYSIS UNIT: An area of land selected as the unit for evaluating the quality of elk habitat.

Discussion: This term and ELK EVALUATION/ANALYSIS AREAS had identical definitions and seem to be used interchangeably. The areas are commonly defined by geographic or administrative boundaries.

Recommendation: The workshop achieved no consensus for selecting one term over the other. These two terms, plus HERD HOME RANGE, POPULATION/HABITAT UNIT, ELK MANAGEMENT UNIT, AND GAME MANAGEMENT UNIT, all attempt to define a specific area within which an analysis procedure can be performed. The first two are defined by animals (by radio locations), the remainder by people. The latter all seem to be arbitrary in the sense that they are drawn to contain a general area of elk habitat rather than a specific area defined by animals. Management units are most often used in management of hunting seasons. All terms should be used as defined. They are not interchangeable.

HABITAT CAPABILITY: The capacity of a given area to meet the needs of elk, either seasonally or year-round.

Discussion: Interestingly, this term is widely used and well-defined in the fisheries literature. The workshop participants considered it nearly equivalent to CARRYING CAPACITY and inapplicable to elk management. See ELK USE POTENTIAL for further discussion.

Recommendation: Should not be used unless used correctly.

HABITAT EFFECTIVENESS: Percentage of available habitat that is usable by elk outside the hunting season.

Discussion: HABITAT EFFECTIVENESS appears to have originated in the road density models as a means of expressing habitat loss associated with open forest roads. It has since been used to express habitat quality, hunting season SECURITY, HABITAT CAPABILITY, CARRYING CAPACITY, and several other conditions not justified by the available data.

Recommendation: We cannot just throw out all existing uses of the term, but biologists and managers should recognize that it has been widely abused. It is usually correct when applied to area. It is usually incorrect when substituted for SECURITY, capability, or productive capacity of habitats. Strive to limit applications to situations meeting the definition.

HABITAT USE POTENTIAL: See ELK USE POTENTIAL.

HERD HOME RANGE: The area a social group of ungulates traverses during normal activities.

Discussion: Although this is a viable concept, we rarely have enough information to use it. It usually includes the total range for a year. See HABIT ANALYSIS UNIT.

HIDING COVER:

Structural definition: Vegetation capable of hiding 90 percent of a standing adult elk from the view of a human at a distance equal to or less than 200 feet. As a site-specific vegetative component of SECURITY, the quality of HIDING COVER varies inversely with SIGHT DISTANCE.

Functional definition: HIDING COVER allows elk to use areas for bedding, foraging, thermal relief, wallowing, and other functions year-round. HIDING COVER may contribute to SECURITY at any time, but it does not necessarily provide SECURITY during the hunting season.

Discussion: Without question, the terms causing the greatest problems and the most confusion involved multiple interpretations and cross-referencing of HIDING COVER and SECURITY. The terms in this subject area often had several different meanings. The implications, particularly with regard to the hunting season, were extremely varied.

Recommendation: Workshop participants were unanimous in concluding that HIDING COVER is a requisite of elk habitat and a component of SECURITY. HIDING COVER alone does not provide SECURITY during the hunting season.

HUNTER OPPORTUNITY: An array of options that allows hunters to choose situations that are personally rewarding.

Discussion: Components of HUNTER OPPORTUNITY are influenced by human activities, hunting regulations, access, time and space, and land management activities. The key to this concept is the ability to select an option that is personally rewarding from several options. An important management decision in providing HUNTER OPPORTUNITY involves the scale of application: statewide, regionwide, forestwide.

KEY COMPONENTS: Areas or landscape features particularly important for maintaining the overall integrity of elk habitat.

Discussion: An acceptable term, other than the potential confusion with CRITICAL HABITAT.

MIGRATION CORRIDOR: Situations, usually linked to topography and vegetation, that provide a completely or partially suitable habitat that animals move through during migrations.

Discussion: This term is easy to misapply because it generally relates to specific locations and can be broadly or narrowly applied. The term usually describes a management problem rather than a definable component of habitat.

Recommendation: Be cautious in application. See TRANSITIONAL RANGE.

Nursery areas: Areas used by a temporary elk social unit consisting of cows and young calves.

Discussion: It is not certain that the term has a specific meaning beyond normal early summer range for large elk cow/calf groups in relatively open habitat. See objectives.

Objectives: The workshop participants identified six terms that are generally used correctly by biologists and managers although they have a high potential for misuse. Sight distance, bull age diversity, nursery areas, calving areas, bedding area, and winter range are seemingly unrelated, but they share a potential for misapplication in situations involving objectives other than protection of elk habitat.

Recommendation: Use these terms correctly in situations where they really are applicable.

Open road equivalents: A measure of access that addresses all types of roads and trails used by motorized vehicles, equating these to a common standard. Frequently used in the computation of habitat effectiveness.

Discussion: Commonly, miles of secondary and primitive road are converted to equivalent primary road miles. Data are available to support such conversions. Various attempts have been made to extrapolate the concept to closed roads, to trails, and to roads and trails during the hunting season. There are no data to support such conversions.

Recommendation: Confine equivalent mileage conversions to evaluation of open roads and recognize that use by any motorized vehicle creates an open road.

Open vegetation: In habitat evaluation models, clearcuts, meadows, and other openings.

Discussion: The term may be useful in verbal discussions but probably defies written definition.

Recommendation: Clarity in descriptions is probably better served by actually saying "clearcuts" and "meadows." Do not use this term.

Optimal cover: A forest stand with four layers, an overstory that will intercept snow, and small openings that provide forage.

Discussion: Other than the clear similarity to old-growth, this was considered a vague term, difficult to measure and define.

Recommendation: Do not use this term.

Population/habitat unit: A discrete association of individual elk bonded together by traditional use of a habitat.

Discussion: By definition, this appears to be identical to herd home range. In use, the unit is usually smaller, indicating some seasonal use by a group of elk. We rarely have enough information to use this concept, but it can be extremely useful when data are available. See habitat analysis unit.

Recommendation: Use when data are available.

Potential elk use: See elk use potential.

Road influence: The effect a road has on elk distribution, behavior, and vulnerability to hunters.

Discussion: This is sometimes interpreted as a zone of influence and is often associated with calculations involving habitat effectiveness.

Recommendation: Use only as justified by existing literature and within the context of existing habitat models.

Security: The protection inherent in any situation that allows elk to remain in a defined area despite an increase in stress or disturbance associated with the hunting season or other human activities.

Discussion: Security is a state of being or a condition. The workshop group agreed that security is a functional concept most important when viewed in relation to the hunting season. The components of security may include, but are not limited to, vegetation, topography, areal extent, road density, distance from roads, size of vegetation blocks, hunter density, season timing, and land ownership.

Recommendation: Very little problem can be encountered in the use of this term if it recognized that hiding cover is site specific, while security is area specific.

Security area: Any area that will hold elk during periods of stress because of geography, topography, vegetation, or a combination of those features.

Discussion: Security area is the structural constituent of security. The workshop group considered this term more meaningful than security habitat. The consensus opinion was that security habitat, even if used as a synonym, can only add confusion and should be avoided.

Security cover: The vegetative cover component of security.

Discussion: The literature review for this term demonstrates a tendency to equate security area and security cover. Although the definition is fairly clear, the consensus of the workshop was that security area is entirely adequate.

Recommendation: Do not use this term.

SECURITY HABITAT: See discussion for SECURITY AREA.

Recommendation: Do not use this term.

SIGHT DISTANCE: The distance at which 90 percent or more of an adult elk is hidden from human view.

Discussion: A measure of the effectiveness of HIDING COVER, but not a measure of SECURITY. See OBJECTIVES.

THERMAL COVER:

Structural definition: For elk a stand of coniferous trees 40 feet tall or taller with average crown closure of 70 percent or more. In some cases, topography or vegetation less than specified may meet animal needs for thermal regulation.

Functional definition: Situations, usually related to vegetation structure, used by animals to ameliorate effects of weather.

Discussion: THERMAL COVER, as much as any other term discussed at the workshop, seems to have developed cadres of adherents and of detractors. One reviewer suggested the substitution of "overstory cover" as a replacement. Discussion also noted that thermal relief can be supplied by topography, other animals, and different combinations of vegetation, water, and air movement.

Recommendation: Acceptable concept but should not be used loosely.

TRANSITIONAL RANGE: Areas where elk concentrate during spring and/or fall. TRANSITIONAL RANGES are generally adjacent to WINTER RANGE and may provide important SECURITY during the fall.

Discussion: TRANSITIONAL RANGE may be important for SECURITY. "Transitional" should not be confused with "transitory." Nearly all MIGRATION CORRIDORS are better described as TRANSITIONAL RANGE.

Recommendation: Use this term rather than MIGRATION CORRIDOR in most cases.

TRANSITORY RANGE: Rangeland created to increase forage production for livestock.

Discussion: This term is sometimes substituted for TRANSITIONAL RANGE. It is not the same thing.

Recommendation: Term should be avoided in any discussion of elk management because it applies directly to livestock.

WINTER RANGE: The area, usually at lower elevations, used by elk during the winter months. See OBJECTIVES.

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